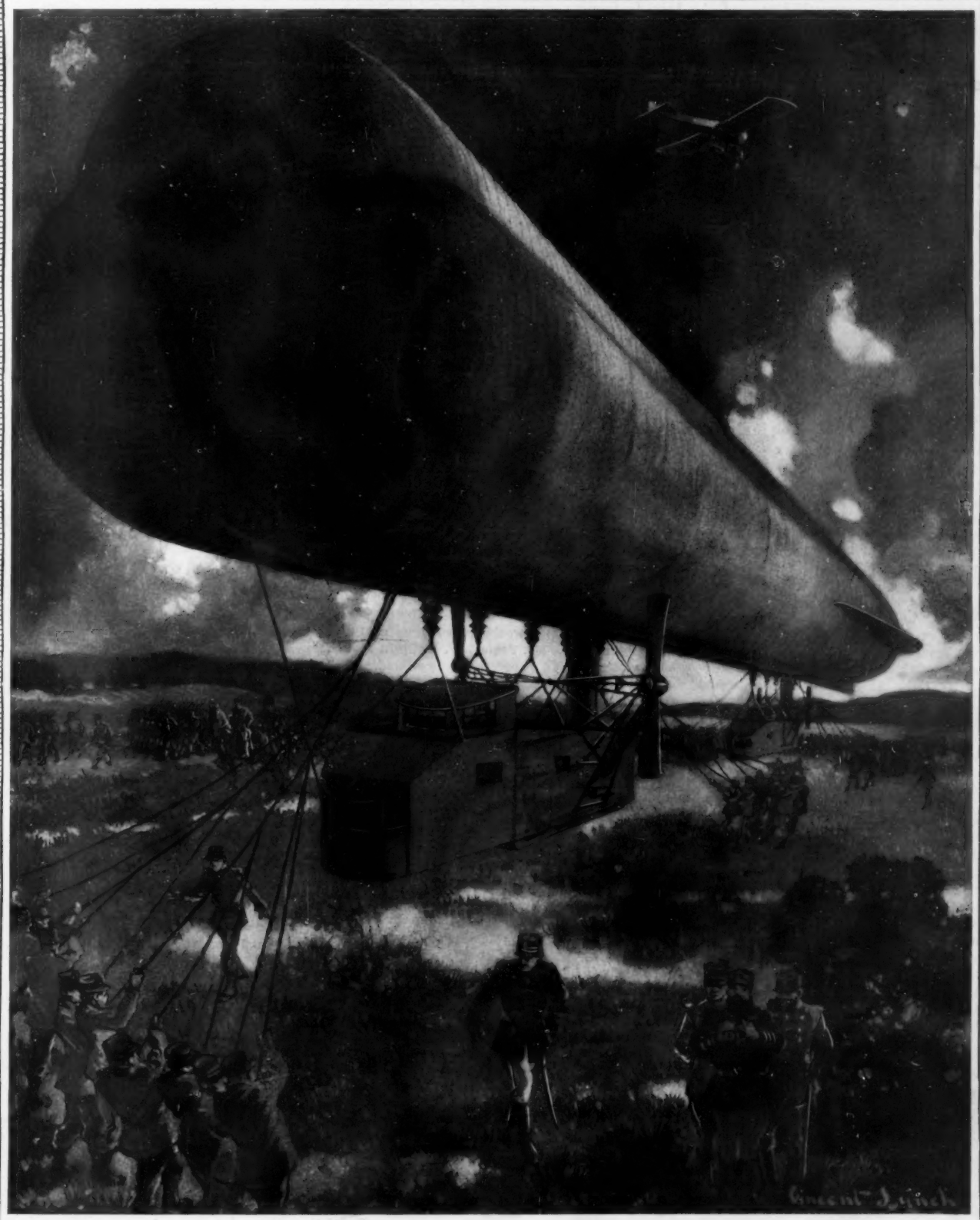
SCIENTIFIC AMERICAN



THE BIGGEST OF FRENCH DIRIGIBLES

The Decline of Our Navy to Third-Class Rank

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Mawson and Wilkes

IN March, 1839, when the ancient belief in the existence of a great *terra australis* surrounding the south pole had been generally abandoned, an English sealer, John Balleny, had the first distant glimpse of the long coast-line south of Australia now known as Wilkes Land. Balleny did not, however, realize the significance of his discovery, and for aught he or the world knew to the contrary he had merely sighted some islands of no greater extent and importance than those which he had previously discovered farther to the east, and which now bear his name.

Early the following year two expeditions, neither of which knew anything of Balleny's discovery, sailed closer to the coast in question and sighted land at several points. One of these, under Dumont d'Urville, discovered Adélie Land and Clarie Land, but did not suspect them to be parts of a continental mainland. The other expedition, under Lieut. Charles Wilkes of the United States Navy, traced the coastline for so great a distance that the leader had no hesitation in naming it "the Antarctic Continent." If Wilkes and his companions had not been sent upon their Antarctic quest in ill-provisioned and half-rotten ships, unsuited in every way for exploring in high latitudes, it is altogether probable that the American expedition would have effected a landing somewhere along the coast, and brought back the definite and detailed information in regard to this region for which, as fate would have it, we have had to wait over seventy years.

During the rest of Wilkes's lifetime and long afterward his discoveries formed a bone of contention among geographers. As lately as 1885 Sir Clements Markham wrote in the ninth edition of the "Encyclopædia Britannica" (art. "Polar Regions"): "In 1839 the French expedition under Dumont d'Urville proceeded south from Tasmania and discovered two small islands on the Antarctic Circle named 'Terre Adélie' and 'Côte Clarie.' At the same time Commander Wilkes of the United States expedition made a cruise to the southward and mapped a large tract of land in the latitude of the Antarctic Circle for which he claimed the discovery. But as a portion of it had already been seen by Balleny, and the rest has since been proved not to exist, the claim has not been admitted."

Even in England, where skepticism regarding the American discoveries has been perpetuated as a heritage from the unfriendly counterclaims of Sir James Ross, few geographers have taken so extreme an attitude on the subject as is indicated in the above paragraph. "Wilkes Land" has appeared intermittently on British charts from at least as far back as 1856, the year in which was published the second edition of A. Keith Johnston's "Physical Atlas," which shows this land as an unbroken coast-line extending for about 1,500 miles in approximately its true position. In recent years the controversy has narrowed down to a question concerning the existence of Wilkes's last reported landfall to the west. Where the American commander thought he saw "appearances of land" to the southwest, and marked Termination Land on his chart, neither the "Challenger" nor the "Gauss" expeditions were able to find land, and the Mawson expedition has now definitely proved its non-existence. Whether Wilkes mistook ice for land, or actually saw the distant coast lifted into visibility by refraction, or—a much less probable supposition—made an error of over a hundred miles in his position, will probably remain a mystery.

On the other hand, the Mawson expedition, which has just completed its labors in the Antarctic, has removed the last vestige of doubt concerning the reality of the continental coast discovered by the American expedition three quarters of a century ago.

The Supreme Court's Pure Food Decision

WHILE the decision of the Supreme Court in the bleached flour case will probably prove a bitter disappointment to many, it was a decision that must have been expected by those who have closely followed the wrangles to which the pure food law has given rise. The Referee Board has shown beyond the shadow of a doubt (and the experiments conducted by *ex-parte* investigators in Europe and America confirm its findings) that very small quantities of injurious substances have no harmful effect.

As we understand it, the decision by no means goes so far as to hold that food which is unfit for human consumption may be treated with harmless proportions of injurious chemicals in order to make it marketable. It does however throw upon the Bureau of Chemistry the task of proving conclusively that a questionable food is so noxious that its sale should be forbidden.

In these days of the high cost of living a food manufacturer of honest intentions should not be too greatly hampered in his effort to place a wholesome product upon the market at a reasonable price. To be sure, the question of wholesomeness may give rise to a hot controversy; but it is for the very settlement of these questions that the Bureau of Chemistry and the Referee Board exist.

That the Bureau is now doing its work competently and adequately we are convinced. The bleached flour case must be regarded as a heritage from a time when the physiological findings of the Bureau were not all that could be desired, and the decision is not to be considered as a reflection upon the present personnel of the Bureau. No doubt the decision will have the effect of increasing the Bureau's work. More analysts will probably have to be engaged, and more stations for the examination of food products established. Congress has been exceedingly generous in its appropriations for the Bureau's work, and there is no reason to suppose that it will be any less liberal in the future than it has been in the past. Surely the task of guarding a whole nation's health is so important that Congress will not spare any expense in attacking it properly.

How to Help the Poor Inventor

WHAT good are laws if inventors are poor? Put money into the patentee's pocket and at once the difficulties of inventing are cleared away—so we would gather from a bill introduced by the Hon. Mr. Samuel W. Smith in the House of Representatives and ordered to be printed.

First of all a workshop is to be created "where all records, books, models, drawings, specifications, and other papers and things pertaining to inventions designed by inventors *without* means shall be safely kept and preserved." Next a commission, to be elected "by direct vote of the people," is to set the price or royalty to be paid the inventor for his invention. By *direct vote of the people*, mind you! Visions of primaries, conventions, caucuses arise. The selection of the commission assumes the importance of a presidential election. All the elaborate political mechanism of the electoral system is to be set in motion.

But the commission presumably has nothing to do with inventors who have money. Only "inventors without means" are considered. The man who can scrape together the statutory Patent Office fees is probably not "without means." Therefore the existing patent laws apply to him. Not for him is the Inventors' Workshop in which his ideas are to be worked out; not for him is that "farm of suitable size and locality," provided for by Mr. Smith, in order to try out "machines adapted for use in cultivation of the soil, and gathering its products." That unfortunate is just rich enough to escape good luck, as it were.

There are some compensations for this lack of poverty. "All inventions worked out at said Inventors' Workshop shall be the property of the United States Government." Instead of falling into the maw of some greedy trust, the poor inventor is to be devoured by his own Government; he is to be propped up with one arm and knocked over with the other.

In a section which contains only two lines, the Hon. Samuel W. Smith disposes with classic brevity of the intricate subject of infringements. "The Government shall pay for all patents and defend all law suits for infringements." The Book of Genesis is not more simply worded. Representative Oldfield of Arkansas, whose compulsory license theories have been made a target by manufacturers, must feel that he is a blind reactionary with medieval ideas when he considers this simple and highly progressive method of dealing with infringement suits with a mere wave of the hand.

The people are not forgotten in Mr. Smith's scheme. "The Government shall establish factories where inventions shall be manufactured and sold direct to the people at cost." Government ownership encroaches on a new field. Nor are the factory workers overlooked. No slave driver, no miserable sweatshop, shall profit by the poor inventors' labors. The workers are "to receive for their labor the full equivalent of their production in maximum uniform wages."

Even the interests of mankind are considered. "No invention or inventions intended to be used in the prosecution of war or destruction of human life, or for the composition of any drugs, foods, or articles injurious to human health and happiness" will be considered at all.

Dreamers, too, are discouraged. Take heed, you Marconis with absurd wireless apparatus, you Edisons with silly phonographs, you Bells with imbecile schemes for telephoning! If your inventions possess no *commercial value* at the time they are conceived, if the world must be educated to use your machines you may not enjoy the privilege of having the Government work out your inventions for you. Go to the trusts, to Wall Street capitalists with your dreams. This is a practical Congress, a practical Government.

During the seventy years of the SCIENTIFIC AMERICAN's existence we have commented on more than one well-meant patent bill introduced in Congress by some representative of the people whose heart bled when he contemplated the plight into which inventors seem to fall. We have even advanced a few ideas on the improvement of the patent system ourselves—but hesitatingly and with some fear that the Constitution of the United States might in some way curb our philanthropic enthusiasm. But all those who have hitherto tried to better the lot of the inventor—ourselves included, we shame-facedly admit—must yield to the Hon. Samuel W. Smith in breadth of vision and largeness of heart. Compared with the epic magnificence of the project which is unfolded in his measure, far too modestly entitled "A Bill to establish an Inventors' Workshop," all other plans seem mean and niggardly.

A Place Where Wireless is Needed

THE island of Tristan da Cunha, in the middle of the South Atlantic Ocean, has from time to time been a source of worry to the British Colonial Office. Communication with this tiny colony of less than one hundred people is very infrequent and irregular, and as the resources of the island are limited, the inhabitants occasionally stand in need of outside assistance. In 1885 nearly all the able-bodied men of the island were drowned while attempting to board a vessel, and the survivors were for a time dependent for existence upon a supply of stores and provisions sent to them by a British man-of-war. Several unsuccessful attempts have been made to induce the people to abandon the island and settle elsewhere. At the present time the Crown Agents for the Colonies are inviting tenders for a license conferring the exclusive rights to occupy three neighboring islands—Nightingale, Inaccessible and Gough—for whaling, sealing and guano gathering, with the provision that whenever the licensees dispatch a vessel to or from the islands it shall touch at Tristan da Cunha for mails and goods, and that they shall also maintain good order in all the islands of the group. An admirable philanthropy would be the establishment of a wireless telegraph station in this isolated spot, after the good example recently set by an English newspaper in putting the little island of St. Kilda into wireless communication with the mainland of Scotland. Of course, such an undertaking in Tristan da Cunha would be far more costly both initially and for maintenance, owing to the great distance of the island from any existing wireless station.

The Aurora Borealis

SOME very interesting recent researches by Stormer and Birkeland on the Aurora Borealis render it probable that this phenomenon is due to corpuscular radiation proceeding from the sun to the earth. These corpuscles are doubtless electrons which are known to have great penetrative power. It is interesting to notice that these observations furnish a means to evaluate the actual degree to which the space in the solar system is a vacuum. It may be expressed by saying that it is as much rarer than the most rarefied vacuum yet produced experimentally as this latter is rarer than the ordinary atmosphere. The density of this interstellar vacuum varies within the limits of the solar system with its distance from the sun; and is doubtless very much more feeble in interstellar spaces far removed from any stars. Outside the Milky Way we may have a vacuum which is almost absolute. The subject has been fully discussed by Birkeland himself in the SCIENTIFIC AMERICAN SUPPLEMENT.

Dr. H. E. Hamberg retired from the directorship of the national meteorological service of Sweden on January 6th, and was succeeded by Dr. Nils Ekholm.

Electricity

Dissipating Fog by Wireless.—The North Railroad Company in France is making experiments on the use of wireless waves for clearing away fog. It is well known that electric waves act upon the water particles which make up fog, so as to dissolve them and turn them into vapor. Following this idea, it is claimed that as much as 600 feet can be cleared up in front of the electric wires which are sending out the waves, the fog being at least partially dissipated, and this will have a great value in practice, especially for railroads and vessels at sea. The latter will have time to avoid each other in this case.

Wireless Telephony from Berlin to Vienna.—Wireless telephony continues to occupy experimenters in various parts of Europe, and although we have no very remarkable progress to report within a recent date, we wish to mention some promising experiments which are being carried out between Germany and Austria. The Nauen wireless station, owing to its high mast, is favorable for long-distance working, and telephoning was done from this plant to the Technical Museum at Vienna, which makes the distance to be 300 miles or more. Owing to special apparatus of a new design, it was possible to hear newspaper articles which were read at Nauen.

Cleveland Electrical Exposition.—Cleveland is planning a great electrical exposition to be held May 20th to 30th in the Coliseum. The project is to be given under the auspices of the Electrical League of Cleveland. The Sixth City claims to lead the nation in many departments of the electrical trade. It is the headquarters for the greatest lamp works, the home of the biggest carbon manufacturing plant, and it boasts of three leading manufacturers of electric vehicles. It holds highest rank in the manufacture of electric cranes and hoisting machinery, and is a leader in the making of batteries. It claims many of the largest electrical machinery plants and its public service company is said to be a model of progress and efficiency.

Memorial to Wireless Operators.—As a memorial to wireless telegraph operators who have lost their lives at sea, it is planned to erect a fountain in Battery Park. The fountain will be of white granite with seats of the same material at either side. At the back will be a column upon which the names of the operators will be inscribed, as follows: Jack Phillips, S.S. "Titanic," April 15th, 1912, Atlantic Ocean. George C. Eccles, S.S. "Ohio," August 26th, 1909, Pacific Ocean. Stephen F. Sczepanek, S.S. "Pere Marquette," September 9th, 1910, Lake Michigan. S. Lawrence Prudhunt, S.S. "Roseerans," January 7th, 1913, Pacific Ocean. Donald Campbell Perkins, S.S. "State of California," August 18th, 1913, Pacific Ocean. Ferdinand J. Kuehn, S.S. "Monroe," January 30th, 1914, Atlantic Ocean.

The New Army Automobile for X-ray Use, which is constructed on designs of the French army physician Major Busquet, is very complete and represents the most recent progress in this direction. In field work of the kind, it has been found difficult to operate the X-ray apparatus with good success owing to the various manipulations which must be carried out, and again a suitable photographic dark room has to be provided. Another point is that quite an amount of power is needed to operate the electric devices if any satisfactory results are to be had. A roomy automobile with 12 horse-power motor and a dynamo has now been developed, the inside of the car being fitted as a laboratory and dark room. A folding operating table is provided with the X-ray bulbs and all needed fittings, and a tent set up against the side of the car forms an operating room. The tent is then folded and stowed in the car. In time of war, it is claimed that all difficulties of operating will thus be overcome, and the car will also be of good service at all times, and can reach the spot quickly. Aviation centers can thus have good aid, especially where a large hospital is not to be found in the locality.

Increasing Motor Output.—A somewhat original method is used by the Brown-Boveri works to increase the amount of power which a given electric motor can be called upon to furnish; for instance, where a factory is using a motor rated at 500 horse-power, the new method allows of getting considerably more out of it, say 700 or 800 horse-power. This often makes it unnecessary to put in new motors for the increase of a plant, hence a great saving. The method depends upon the fact that in the induction motor the power factor often has a low value, so that the motor does not furnish nearly as much power for its size as it would were the power factor of higher value or near to unity. For rolling mill motors, where these are subject to severe strains and overloads at times, the motor must be very much larger than the average power would call for, hence it is an advantage to be able to use a smaller motor for the same power. This is done by a small extra device in the shape of a one horse-power motor, coupled to a rotating commutator, and this acts to change the value of the power factor and increase the output of say a large 1,000 horse-power motor with which it is used. The small device is connected to the circuit of the large motor.

Science

A Unique Collection of Books has just been acquired by the Library of Congress from Mr. Bertram Dobell of London. It consists entirely of works printed for private circulation, 1,500 in number, covering a wide range of subjects, and representing a labor of forty years on the part of the collector. Mr. Dobell has prepared an interesting descriptive catalogue to accompany the collection.

Mink Breeding.—A contribution to the growing industry of fur farming has been undertaken by the U. S. Biological Survey in the shape of experiments in breeding minks for size, quality of fur and disposition. A mink farm has been started near Prichard, Idaho, in the Cœur d'Alene National Forest, and similar experiments are under way in the National Zoological Park in Washington, D. C.

Earthquake Construction has now reached a very practical stage in the seismic districts of Italy, where all new buildings are being erected under strict supervision with respect to their ability to resist earthquake shocks. Prof. Omori, the Japanese authority, has estimated that 99.8 per cent of the deaths in the great Messina earthquake of 1908 would have been prevented if the buildings had been properly constructed.

The "Discovery," which was built for Capt. Scott's first expedition and was frozen in the Antarctic ice for three years, was subsequently sold to the Hudson Bay Company, and Scott was unable to obtain her for his second journey to the Antarctic. Mr. G. F. Stackhouse has, however, been more fortunate, having secured the use of this stanch vessel for his expedition, which is to seek King Edward VII. Land next Summer.

Martian Frosts.—The following telegram has been received from Lowell Observatory: "A late frost, a unique phenomenon, occurred on the night of March 3rd on Mars, in the region to the north of the Propontis, and was still visible at 2 o'clock of the Martian afternoon. The frost was parted from the north polar snow by the blue border, which was undoubtedly water, that marked the melting cap."

Suttee, the ancient Hindu custom of burning widows on their husbands' funeral pyres, was made illegal by the government of India in 1829, but cases of its occurrence are still occasionally reported. The London *Times* describes the voluntary suttee of a young widow last June at Yaraule, a village in the Mainpuri district. The act was carried out in the presence of a crowd of from 1,500 to 2,000 people. Several natives who assisted at the ceremony have been sent to prison.

The Death of Prof. Robert K. Duncan.—Dr. Robert Kennedy Duncan, Director of the Mellon Institute of Industrial Research of the University of Pittsburgh, died recently after an illness of several weeks at his home in Pittsburgh. He contributed articles on scientific topics to many periodicals, including the SCIENTIFIC AMERICAN. In 1907 he inaugurated at the University of Kansas a plan of industrial fellowships which subsequently has been developed to large proportions in that institution and at the University of Pittsburgh.

News from the "Polar Bear" Expedition.—A dispatch from the Signal Corps station at Circle City, Alaska, dated November 11th, announces the arrival at that place of a courier who brought a message 250 miles overland from the Arctic coast stating that the power-schooner, "Polar Bear," with a party of explorers and big-game hunters on board, is frozen in the ice off Demarcation Point, where it will, necessarily, spend the winter. All the party were reported well. A quite unusual number of vessels are understood to be fast in the ice along the Arctic coast of Alaska this season, including part of Stefánsson's Canadian Arctic expedition.

Casein.—Recent notable developments in the production and industrial uses of casein form the subject of an interesting report from Consul W. H. Hunt, stationed at St. Étienne, France. Casein, which is the principal albuminoid matter of milk, is now obtained by electrolysis, according to the following recently invented process: In the middle of a large vat full of skimmed milk heated to a temperature of 80 deg. C., a porous vessel is placed containing a 5 per cent solution of caustic soda; an iron cathode is plunged into the soda, and a rod of carbon, serving as an anode, into the milk. An electric current sets free the phosphoric acid contained in the milk, and the casein precipitates. As compared with the method of obtaining casein by the use of acids or rennet, the cost of this process is very low, the yield is greater, and the casein produced contains no foreign ingredients. Vegetable casein, now produced on an extensive scale from the soya bean, can be put to the same uses as animal casein. The principal use of casein is in the manufacture of galalith (milk stone), used as a substitute for ivory, tortoise shell, celluloid, etc. Penholders, frames, purses, phonograph disks, and a great variety of other articles are now made of galalith. It is also used as a chemical fertilizer. Several other casein products have recently been introduced.

Aeronautics

The "Loop" and its "Loopers."—Up to the present time no less than thirty-one pilots have looped the loop, according to *L'Aerophil*. Of these, Hamel, an Englishman, and Gilbert, a Frenchman, have looped the loop with passengers.

A New Tri-plane.—Eugene Bouillet of Long Island City, N. Y., has secured patent No. 1,084,248 for a triplane which has an upper supporting surface with the rearwardly projecting lateral tips, an intermediate supporting surface with controlling surfaces in its lateral extremities and a rectangular lower supporting surface, the said surfaces having substantial flat forward and rearward portions and a transversely extending arched central portion.

German Aeroplane Motor Competition.—Another aeroplane motor competition is to be held in Germany. The sum of $35,000 is to be awarded for the best water-cooled and air-cooled motors of 80 to 200 horse-power. The tests will determine general working of the motors, the efficiency, consumption of fuel, etc., and endurance. Among the points that will be counted in favor of a competing engine, the possibility of using cheap and safe material of German origin will be included. Points to be avoided are: Long duration of preparations for the tests, special requirements as regards lubricating oil, decline of efficiency in the long distance trials, vibration, breakdown of carbureters, an inconvenient shape for fitting into the aeroplane, and the supply of materials from abroad.

A Flying Tug-boat.—M. Maurice Colliex, who has been trying to solve the question of hydro-aeroplanes of large dimensions, capable of flying out over the sea for an entire day, made his first flight, recently, with a new gigantic sea plane, which might be called a flying tug-boat, built by the Voisin brothers. It has the regular ship-like under-structure characteristic of Curtiss hydro-aeroplanes, and looks something like a small river tug. Even the funnel in the middle is not missing. The hull of the little boat is 26 feet long, with a beam of 7 feet. The wings, which form a sort of tandem biplane, two super-imposed planes being at the back and two in front, are about 82 feet long, and have a spread of about 150 square yards of canvas. There are two motors of 200 horse-power each, and the machine is capable of flying with a useful weight of about two tons. It can carry oil and fuel enough for a flight of about 100 miles. Colliex tested the machine on the Seine, near Triel. It rose easily from the water, and alighted without difficulty.

Fog Observations for Aeronauts have been made regularly in Germany since March 1st, 1913, under the auspices of the *Luft-Fahrzeug-Gesellschaft*, at a small group of stations surrounding the town of Bitterfeld, where the service has its headquarters. Dr. Rotzoll, who is in charge of this novel undertaking, points out in his first report on the operations of the service that a foggy atmosphere is one of the greatest dangers encountered by airships, and it is therefore of the utmost importance to keep the aeronaut informed of the location of fog, its density, the height to which it extends, etc. Experienced meteorological observers are now keeping a record of fog at places around Bitterfeld, and are prepared to send reports by telegraph or telephone whenever called upon to do so. They report the density of fog in terms of "visibility-distance"; i. e., the maximum distance at which certain prominent objects, such as steeples, smokestacks, etc., can be seen. In order to measure the height of fog, apparatus is now being constructed which will be sent aloft attached to a captive balloon or kite; when the instrument rises out of the fog into drier air the change in hygrometric conditions will be registered electrically at the other end of the wire leading to the ground.

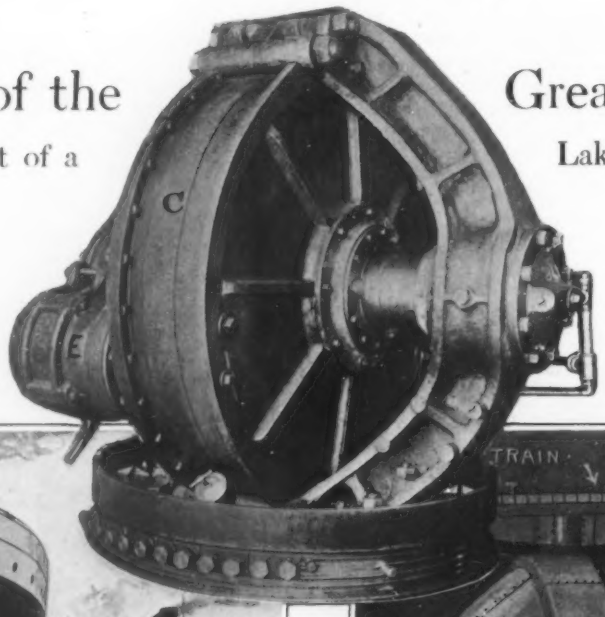
The Italian Air Fleet.—The Italian airship M-3 is finished and is now beginning her trials, while the P-3 has terminated these with success, and is said to be destined for Turin. These two additions to the Italian airship fleet bring its numbers up to ten, consisting of five of the P—piccolo = small—class, three of the M—medium—category, the "Citta di Milano," built by Ing. Forlanini, and the "Parseval." We are informed by the *Engineer* that the first example of a new semi-rigid series, distinguished by the letter V after the designer, Capt. Verduzio, is under construction near Rome, and will have a capacity of 15,000 cubic meters (529,721 cubic feet) and a speed of 90 kilometers (56 miles). In Milan, another Forlanini vessel will soon be begun, with a capacity of 15,000 cubic meters, and therefore larger than the "Citta di Milano," besides having greater speed. The plans are also said to be well ahead for the new G—grande = large—type, which will be rigid and have a capacity of over 30,000 cubic meters (1,059,442 cubic feet). In the aeroplane department, three squadrons of seven machines will be added by June to the sixteen already existing. By the end of the year, there will probably be in Italy seventeen military aviation squadrons, each of seven aeroplanes, together with thirteen airships, of which the newest and largest will be the new Forlanini ship, the V-type unit, and the large G.

Bucking the Ice of the Great Lakes With a Gyro

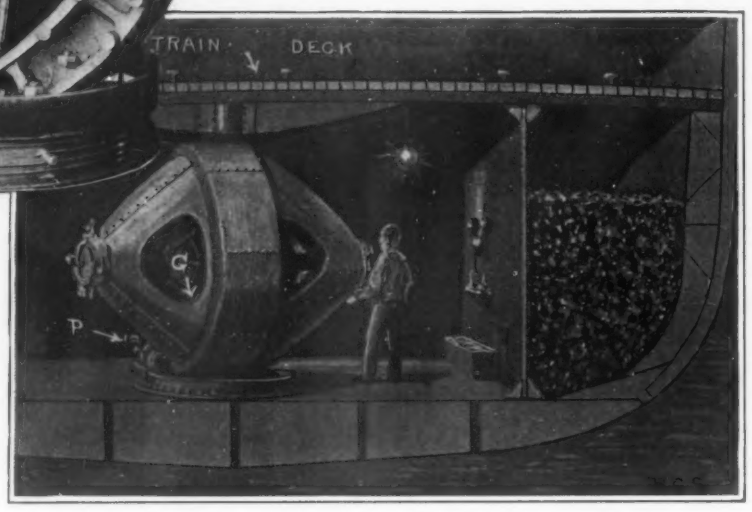
The Equipment of a Lake Car Ferry Steamer

How the Rolling Motion of a Great Hull Makes it Possible for a Ship to Batter Her Way Through Ice Fields

In Order to Make the "Ashtabula" Roll, and Thus Enable Her to Work Her Way Out of the Ice, She Will be Provided With an Active Gyroscope



A big steamer on the Great Lakes having a channel broken for her by small tugs with special rudders.



The manner in which the stabilizing and rocking gyro will be installed on the "Ashtabula." G is the incased gyro; P is the precessing engine.

The gyroscope is shown in the top picture. C is the vacuum case containing the active type of gyro; E is the electric motor which drives the gyro.

MANY millions of tons of freight are hauled annually by vessels upon the Great Lakes, and many more millions could thus be carried were it not for ice. On an average, general navigation upon these highways of inland shipping is limited to a period varying from seven to eight months—depending upon the severity of the winter season.

It is not necessary that the Great Lakes, from shore to shore, should be frozen over to halt the activities of freighters; it is quite enough to have harbors closed by the ice. In order to reduce the impediment of this lesser evil, it is customary to employ small vessels to break passages clear for inbound or outbound craft when the rest of the lake area is open to navigation. Strange though it may seem, these modest craft do what their big brothers, the freighters, cannot do even though many efforts have been made to fashion some of the lake steamers so that they can "buck the ice" effectively. Despite the fact that the Russian ice-breaker "Ermak" has done excellent work, that ship has its limitations. It is not always possible to get sufficient headway to ride up on the ice and break it down, as the "Ermak" does, and, besides that, she is fit for that service alone and powerfully—we might almost say extravagantly—engined for that work.

The ice-breaking tugs on the Great Lakes are equipped with exceptionally large rudders which can be swung quickly from side to side by a steam-steering engine and thus given a rhythmic rocking motion, tuned to their natural rolling period, by which it is possible for them to deliver first on one side and then on the other crushing blows to the ice while being driven vigorously forward by their screws. The result is a capacity to break the ice in a manner which the straight, bow-on attack of far heavier vessels would not accomplish even though it be possible for them to poke their stems up and on the floe.

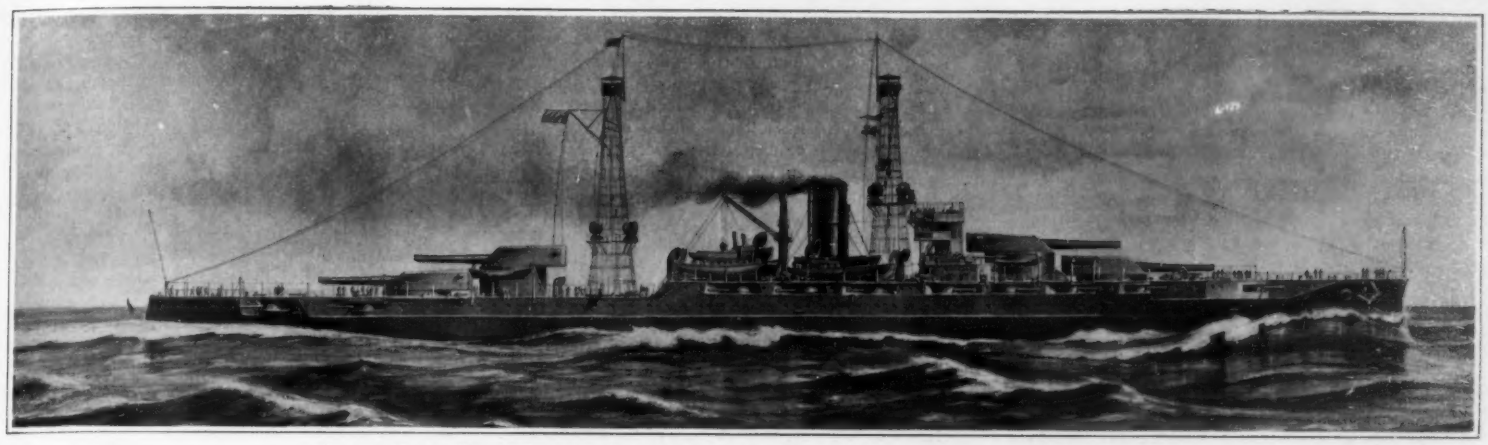
The big car ferry steamer "Ashtabula," a vessel of 4,500 tons, is to be equipped with a unique apparatus by which that ship can be rocked like the small tugboats when attacking the ice. In this way, the rolling motion of her great body will make it possible for her to batter her way through the ice fields and to get in and out of harbor unassisted. The "Ashtabula" will be fitted with a Sperry stabilizer of the active gyro type, which when not in service to steady the craft in a seaway, can be made to roll her agreeably to her natural period. The Sperry installation will take up but a modest amount of space and will weigh less than one per cent of the ship's total displacement. When stabilizing the "Ashtabula" the mechanism will receive its inciting impulses from the waves themselves. When rocking the ship, the promoting action will be arbitrarily induced by a small auxiliary apparatus which will affect the two little pilot or sentinel gyros which bring the great gyros into action either to one or the other side.

The car ferry steamer "Ashtabula," which plies between Ashtabula Harbor, Ohio, and Port Burwell, Ontario.

The car ferry steamer "Pere Marquette" caught in the ice outside of a harbor.

Briefly, the active force employed is centered in a large rapidly revolving flywheel in which the principal mass lies in the rim, and the faster this gyro turns the greater its upsetting or corrective energy when swung laterally to varying degrees out of its normal fore-and-aft vertical plane of revolution. Thus, within a moderately small compass, an immense measure of disturbing or counter-balancing energy can be aroused. It takes but a relatively small amount of power on the part of a precession engine to turn the gyro to right or left as far as need be. Of course, when on duty, the big gyro is steadily spinning. The precession engine is called to service by two little gyros: one regulating the time of action and the other the degree of movement. These extremely sensitive sentinel gyros operate, by means of electrical connections, the throttle of the engine control and the manner of applying the steam to what we might call an ahead or a backing motion—in this case resulting in movements on the part of the gyro to right or left.

The object of the auxiliary apparatus referred to will be to artificially excite the pilot gyros by a purposely applied rocking motion. This, in turn, will be translated to the big gyro, and its periodic precession will cause the 4,500-ton ship to rock in unison. This opens up an entirely new field in the problem of breaking through ice that interferes with traffic, and the working of the installation in this case will be watched with intense interest by ship owners as well as engineers.



The 31,000-ton "Pennsylvania" of the United States Navy. She will carry twelve 14-inch guns.

The Problem of Our Navy

III.—The Decline of the United States Navy to Third-Class Rank

By the Editor

BETTER than any learned treatise could have done, the events of the Spanish war taught the American people the value of a preponderance of sea power. When Dewey crumpled up the Spanish fleet at Manila and Sampson strewed the southern coast of Cuba with the burning wreckage of Cervera's squadron, the decisive influence of sea power, always recognized by the naval expert, became self-evident, even to the man in the street.

The effect of this object lesson upon the country at large and its representatives in Congress was immediate. Proud of its navy and the international prestige which followed upon its victories, and realizing that what the navy had won a strong navy alone could keep, Congress lent a willing ear to its technical advisers, and systematically and most liberally set itself to the task of building up a navy that should be equal to the heavy responsibilities entailed upon the country by its acquisition of such widely separated possessions as Porto Rico and the Philippine Islands, and by its occupation of the island of Cuba. Our navy grew, literally by leaps and bounds, and within half a dozen years of the conclusion of peace it stood second in strength, with a commanding lead over that of Germany, having as its first fighting line not less than twenty-three first-class battleships built or under construction, to say nothing of eleven armored cruisers—the latter a type which Japan, not many months before, had not hesitated to place in the first line at the great battle of Tsushima.

But it so happened that in the very year, 1905, which found our navy in such a commanding position, there was built in England a new type of battleship, the "Dreadnought," which was destined to work a revolution in the relative standing of the navies of the world, by relegating all existing battleships to the second line.

So vastly superior in size, speed, gun power and defensive qualities was the new ship, that it was recognized as the only type that could be used effectively in the first line of battle; and it was realized that the nation which could most quickly build and equip a fleet of these ships would hold the balance of sea power with all that this implies. The leading powers recognized that the dreadnought had entirely upset existing conditions, and all but ourselves accepted the burden thus laid upon them, enlarged their naval appropriations accordingly, and made haste to build up a new battleship fleet along dreadnought lines.

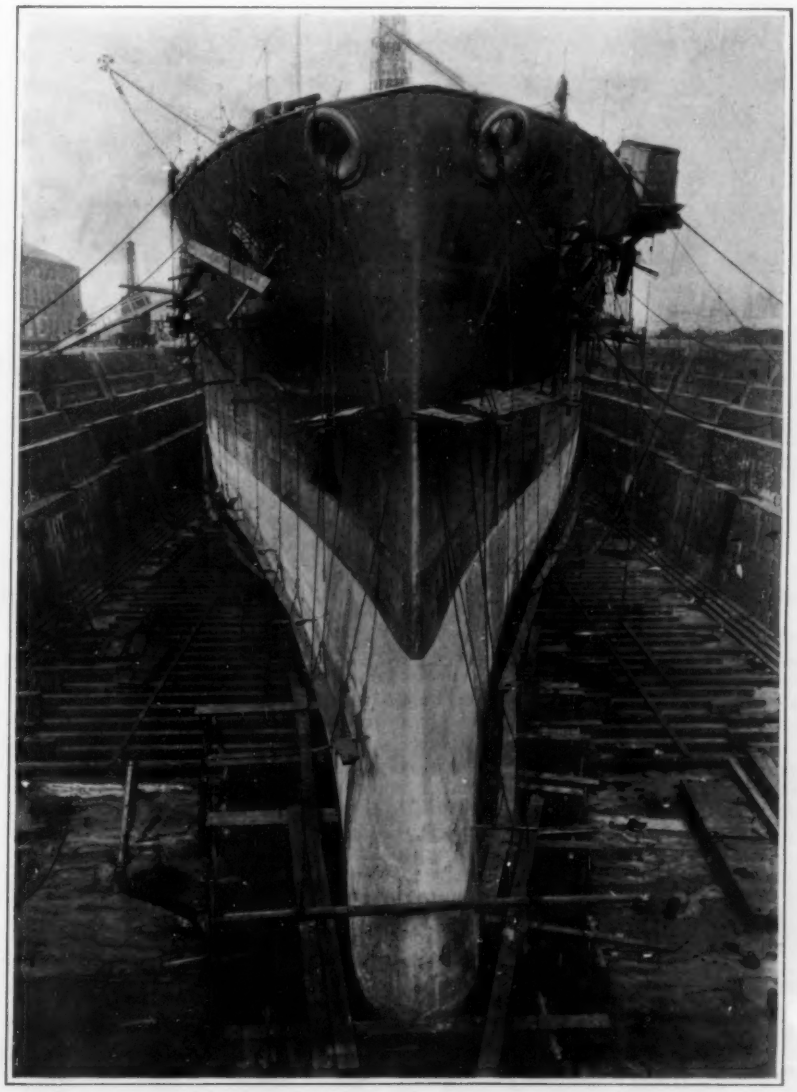
Unfortunately, Congress failed to appreciate the serious nature of the crisis; and at the very time when appropriations should have been increased to meet the new conditions, they were reduced—with the result that our first line of battle (and that means the navy, so far as the winning of decisive engagements is concerned) has sunk to the third rank, with France and Japan pushing us very closely for pre-eminence. But the story of the rise and decline of our navy since the war with Spain is told by the statistical figures of the following table.

An analysis of the above table shows that in the seven years, including and intervening between the Spanish war and the opening of the dreadnought era, Congress authorized the construction of new battleships at the average rate of two and one half ships per year,

APPROPRIATIONS FOR ARMORED SHIPS SINCE THE SPANISH WAR.

Date.	Battleships.	Armored Cruisers.
1898	Three	.....
1899	Four	Two
1900	Two	Three
1902	Two	Three
1903	Five	.....
1904	One	Two
1905	Two	.....
1906	One	.....
1907	One	.....
1908	Two	.....
1909	Two	.....
1910	Two	.....
1911	Two	.....
1912	One	.....
1913	One	.....

and of battleships and armored cruisers combined at the rate of four ships per year; whereas during the eight years covering the dreadnought era, when a far-seeing Government would have accelerated construction, we have authorized new battleships at the low average rate of only one and one half vessels per year. And let it never be forgotten that during these years of decline in relative strength, our international policies have grown in scope and have been proclaimed with greater emphasis than ever before.



Bow of the "New York," our first dreadnought to carry 14-inch guns.

Why is the Dreadnought Supreme?

Now we can well understand that to many of the people of the interior States, and to many of their representatives in Congress, for that matter, the sudden announcement that their fine navy, for the upbuilding of which Congress had appropriated money so freely, has in a few years dropped to third-class rank, will come with a shock of surprise and provoke a strong doubt as to its truth. That doubt has been freely expressed, and by no one so strongly as by those senators and representatives whose constituencies are to be found in the interior States, where, in the nature of things, knowledge of naval affairs is not so broad, and familiarity with the development of naval *materiel* is not so intimate, as in the maritime States.

The present false conceptions of our naval standing, the failure to realize the imperative necessity for maintaining our navy in the very front rank among those of our possible competitors, and the indifference of the people and Congress to the fact that, ever since the dreadnought era began, we have been falling rapidly to the rear—all this is due to lack of information, to much positive misinformation, and more than anything else, perhaps, to a belief that no foreign power will dare to attack us—a belief which is founded partly upon our past naval successes

and partly upon our feeling of national invincibility, that is to say, upon what remains of a certain traditional "lick-creation" attitude toward the great outside world.

But the day has gone by, never to return, when the ability of a nation to win a great naval war can be measured in terms of its material wealth and its undisciplined courage. *The modern development of the technical arts, to which this country has contributed so greatly, has put a heavy discount upon mere wealth and courage, and has set a heavy premium upon the material instruments of war—the 14-inch gun, the telescopic sight, the torpedo, the destroyer and the submarine!*

But the "man behind the gun"? Yes, we have a good man behind the gun; but so has Germany, so has Japan. The 14-inch, rifled gun, sending its high-explosive shell unerringly to the mark across five miles of water, is no respecter of persons. The stalwart American gun-pointer at one end of that five miles and the puny Jap at the other are toeing the line in a scratch race, a race which will be won, not by brawn and muscle, not by unconquerable courage, not by any dreams of a glorious past, but by the steady nerve, the keen eye, and the poise that comes of unremitting training and discipline in the years gone by.

Now let us carry the line of thought a little further and remember that what is true of a single gun is true of a whole ship's battery, and that, if gun is equal to gun, and the marksmanship is the same, by all the laws of probability, the ship that carries the greatest number of guns and delivers the heaviest broadside will win the fight.

To-day, even more than when Napoleon uttered his famous dictum, it is certain that "Heaven fights on the side of the heaviest artillery;" and it is because the dreadnought carries a broadside of such overwhelming superiority that no pre-dreadnought can engage it with the slightest hope of success. A 12-gun "Wyoming" might silence a 4-gun "Connecticut" in the first five minutes of an engagement, and in 10 minutes might conceivably leave it in a sinking condition. But, according to Representative Witherspoon and the "small navy" men in Congress, matters would be equaled if twelve 4-gun "Connecticuts" were pitted against four 12-gun "Wyomings;" and since herein lies one of the most plausible fallacies of those who fail to see the importance of the dreadnought question, we shall now give, *seriatim*, the reasons that have relegated all but twelve of our thirty-nine battleships to the second line.

I. *Overwhelming concentration of gun-fire.* It is generally agreed that because of the danger of fighting in the head-on position (which exposes a ship to the risk of a raking fire in which more shells would strike and when they struck might pass through the whole length of the vessel), that future engagements will be fought broadside to broadside, with the two fleets traveling on parallel courses, and the ships disposed in "column formation," that is to say, ship behind ship, with a suitable interval of about 450 yards between the stern of one ship and the bow of the ship that is next astern. In this formation a line of four "Wyomings" would be roughly about one mile in length, and a line of twelve "Connecticuts" nearly four miles. The "Wyomings," because of their superiority in speed of about three knots, would elect to place themselves opposite the head of the column of "Connecticuts," and in these relative positions, the four "Wyomings" would be able to oppose forty-eight 12-inch guns against the sixteen 12-inch guns of the four leading ships of the "Connecticut" line. The "Wyomings," having the advantage in speed, would elect to fight at a maximum range of 10,000 to 12,000 yards; and since the successive ships down the "Connecticut" line would be at increasing distances from the "Wyomings," the after part of their line would be out of effective range. The result would be that the four "Wyomings" would be able to crush the head of the "Connecticut" line by overwhelming gun fire, and then commence dropping back until the whole fleet had been silenced. The "Wyomings" would be punished, of course; but their enormous volume of fire would fairly smother that of the ships at the head of the enemy's line and would afford a strong protection against his gun fire.

But suppose that the twelve "Connecticuts" found themselves in line against twelve "Wyomings," with forty-eight 12-inch guns opposed to one hundred and forty-four!

II. *The all-big-gun battery makes salvo firing accurate.* The fact that only one caliber of gun is carried in the dreadnought's main battery gives it an enormous advantage over the pre-dreadnought. The "Connecticut" carries 12-inch, 8-inch and 7-inch guns. If all of these are engaged, it is impossible to distinguish the splash of the several guns, and the work of the spotter is rendered difficult and uncertain. With the guns all of one size, the spotter can determine the mean point of fall and correct the elevation of the whole ship's battery accordingly. Because of the terrific punishing power of the 12-, 13½-, and 14-inch gun, the commander-in-chief will prefer to fight his dreadnoughts at the maximum range at which he can hit the mark and trust to the accuracy of his fire to land on the enemy that first salvo which will go far to win the fight. At such ranges, only the four 12-inch guns of a "Connecticut," "Georgia," or "Maine" would be available—and even these, being of an older type, would be greatly outclassed by the more modern guns of the dreadnought. The 8-inch, 7-inch and 6-inch guns would not even be manned during the fight.

III. *The more modern equipment* of the dreadnought's guns would enable them to do more accurate and faster firing.

IV. *The armor of the dreadnought* is thicker, of better quality, and is better distributed.

V. *The saving in personnel on the dreadnought* is a most valuable feature. The "Connecticut" carries 1,000 officers and men for four big guns, the "Pennsylvania" carries the same number for twelve big guns—250 men per gun for the pre-dreadnought and only 84 per gun for the dreadnought.

VI. *Lastly, the relative damage of a hit by torpedo or gun*, tending to sink the ship, is one half as great on the 31,000-ton "Pennsylvania" as it is on the 16,000-ton "Connecticut." Furthermore, the compartmental subdivision of the dreadnought as a protection against mine and torpedo is more elaborate and effective than on the pre-dreadnought type.

We have said enough to show that the dreadnought, as a fighting unit, is in a class by itself. To send a fleet of pre-dreadnoughts out to fight a fleet of dreadnoughts would be suicidal. The case was aptly put by Mr. Daniels, the Secretary of the Navy, in his examination before the House Naval Committee, when he said that the captain who fought a pre-dreadnought against a dreadnought would be deserving of court-martial.

On the new dreadnought rating, then, where do we stand? Naval statistics show that there is one first-class navy, the British, with forty-two of this type built and building; one second-class navy, the German, with twenty-six such ships; and three navies of the third class, that of the United States with 12; France with 11 and Japan with 10 dreadnoughts. And both France and Japan, be it remembered, are building faster than we. They are adding to their dreadnought fleets at a rate which in a few years' time will relegate us to the fifth position.

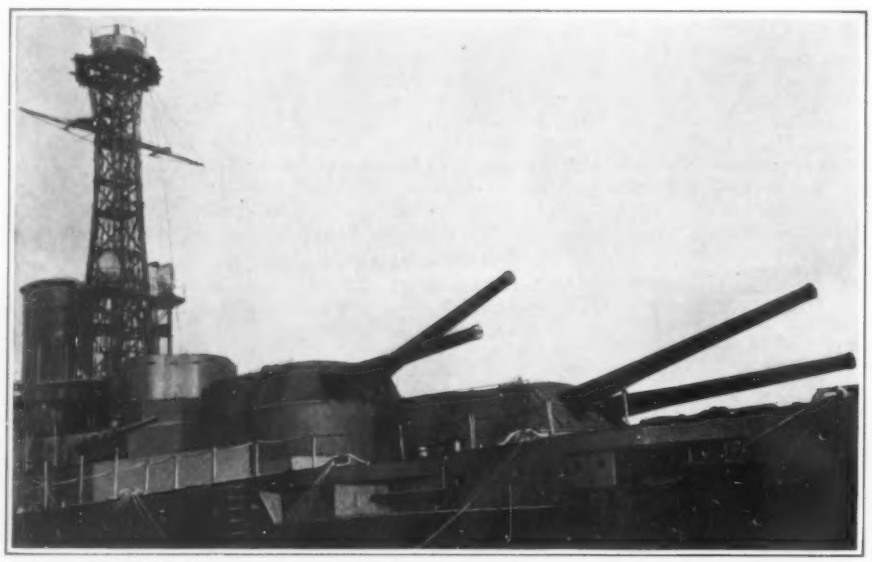
Unless Congress listens to the advice of our Naval Board, the drop of the United States to the low rank of fifth in naval strength is as certain as the ebb and flow of the tides and the rise and setting of the sun.

And what then?

The SCIENTIFIC AMERICAN is opposed on principle to the forecasting of possible hostilities with powers with which the country is on friendly terms; but in the present article such a forecast seems justified as proving the disastrous results which might follow from our neglect to provide a navy equal to our needs.

Let us suppose that two years from now Great Britain, estranged by our breach of faith (in the event it should not be rectified) on the canal tolls question, agreed to maintain an attitude of neutrality, while Germany, by the purchase of a base in the West Indies, challenged our Monroe Doctrine in its relation to the security of the Panama Canal. Let us suppose that, released from anxieties at home, Germany dispatched her whole first line of twenty-six dreadnoughts, and her second line of fifteen pre-dreadnoughts (including all ships dating since 1901) to the Caribbean. Where should we stand? Against her twenty-six dreadnoughts we could oppose twelve; against her fifteen pre-dreadnoughts we could oppose sixteen of the same date. Can anyone suppose that our first line could prevail against one of more than double its strength? And with the ships of our first line sunk, captured, or fleeing for a home port, what would become of our older ships, when the victorious first and second line of the enemy joined forces to crush our remaining second line, composed of "Connecticuts," "New Jerseys," and "Maines"?

And suppose Japan, smarting under the sting of our Asiatic exclusion, seized the opportune time, and swept down upon the Philippines, Guam, Hawaii, and, with no fleet to cut her lines of communication, established a base upon the Pacific Coast, and began to land her veteran troops of the Russo-Japanese war. That would be a startling object lesson in the necessity for the provision of adequate sea power by a nation so situated as our own—an object lesson, the meaning of which the people, even of the States most remote from the sea, and most opposed to the growth of our navy, surely would not fail to grasp.



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The forward 14-inch guns of the United States dreadnought "New York."

Meteorological Service in the Caribbean

THE next agricultural appropriation bill will probably provide for the establishment of about sixteen meteorological stations in the West Indies and elsewhere about the Caribbean Sea, under the direction of the United States Weather Bureau, for the purpose of maintaining an efficient storm-warning service in that part of the world. The need of such a service will, of course, become especially urgent with the opening of the Panama Canal. The first extensive meteorological service in the Caribbean was established by the Weather Bureau in 1898, primarily for the protection of the American fleet during the war with Spain. Shortly after the war most of the regular observers were recalled, and the work was continued on a small scale by native observers, cable operators, and the like. In recent years a telegraphic weather service has been maintained only during the hurricane season. The new stations will telegraph twice-daily observations throughout the year, and wireless telegraphy will be employed at places where the regular telegraph facilities are not adequate. A central observatory will be established in the Canal Zone. Wireless weather reports from and to vessels will form an important feature of the new service.

Development of the Parcel Post

THE last annual report of the Postmaster General, published in December, states that during the first six months of the parcel post (January to June, 1913) approximately 300,000,000 parcels were handled, and of this number more than 2,500,000 were insured. Insurance rates were readjusted on July 1st, so that insurance up to $25 costs only 5 cents, and from $25 to $50, 10 cents. A collect-on-delivery service was established July 1st; charges up to $100 are collected for a fee of 10 cents. Increases in maximum weight limits and reductions in rates of postage for certain zones have twice been made since the parcel post was established. Nothing could better justify the existence of the new service than the fact that twenty million rural dwellers now have a house-to-house collection and delivery of parcels; a luxury once peculiar to cities and towns. An important step now in contemplation is the consolidation of the third and fourth classes of mail. Books will be admitted to the parcel post on and after March 16th, 1914.

The Kaibab and the Coconino National Forests adjoin each other. Yet it takes from two to three days to go from one to the other across the Grand Canyon of the Colorado.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Leinert Liquid Weigher

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of January 24th, in a short paragraph describing the Leinert liquid weigher, you state that this apparatus "consists of a pair of equal-sized tanks so arranged that when one is filled up to a standard level, it automatically shifts the feed to the second tank." This is an error, as when one tank is filled to a definite weight, it automatically shifts the feed over to the second tank.

New York. THE LEINERT LIQUID WEIGHER CO.
W. LEINERT.

How to Use Old Decayed Elms

To the Editor of the SCIENTIFIC AMERICAN:

Knowing of the ravages that certain beetles and pests have been making with the grand old elms in Massachusetts and other nearby States, may not the following suggestion prove of advantage to owners of trees so killed or dying?

When the owner of such valued trees sees that they are going to die and that nothing can be done to save them, instead of cutting them down, allow them to remain as before. At their base, after careful preparation of the soil, plant a great abundance of Virginia creeper or woodbine, or some rapid-growing vine that will stand the winter breezes. In time such growth will entirely cover the tree, reaching to the farthest limits, and instead of having a bare skeleton of the past beauty, it will again bloom with a grandeur not before known.

Possibly some vine or creeper can be found that will prove much better for the purpose than the two mentioned. The State authorities could well give this careful thought, and following intelligent experimenting, again beautify the remains of past glory.

Los Angeles, Cal. PIERSON W. BANNING.

Snow Removal

To the Editor of the SCIENTIFIC AMERICAN:

If a road-maker with tons of earth to dig away in the shortest possible time should propose to do the job with hand shovels he would not be likely to receive the contract. Yet this antiquated method is regarded as sufficient when it comes to clearing a great city of snow! And why? Probably because it has never occurred to anyone that more effective means might be devised. And yet it would seem perfectly feasible to apply to snow removal something of the modern methods used in removing dirt. A power shovel, mounted on a motor truck, operated by the same power that operates the truck, would seem not difficult to invent. Horse ploughs that pushed the snow from the middle of the street, leaving it in a continuous high ridge along the sides, could then be followed by such power shovels to load the snow into wagons. Without figures at hand it is impossible to say with accuracy how much faster such loading could be accomplished, but it is evident that it would be many times speedier than hand shoveling. And a power shovel would be able to handle frozen snow as readily as loose snow.

The objection will be raised that the present slowness is caused not alone by the men; that sufficient horses and wagons cannot be procured for swifter removal. This raises a second consideration; the possibility of greater co-operation between the city cleaning departments and the street railway companies. Why should not the latter's rails and power be used to aid the city by hauling the snow wagons across town? It is as easy (or, if not, it could readily be made easy) to hitch a wagon behind a service car as behind a horse. Thus the horses, having a shorter haul—only from the point on whatever avenue is being cleared to the nearest cross-town line—could do more hauling, and any given wagon would make several times the present number of trips. Of course this would involve some inconvenience to cross-town passengers; but such power-hauling might be resorted to only out of rush hours, and at night.

And in another way the railway companies could aid. At present a plough or a brush runs down the tracks, throwing the snow into the roadway for removal. Thus the amount of snow in the roadway is doubled, and half the snow in the street is handled twice. What would Col. Goethals have thought of a proposal to throw the dirt of the Culebra cut into some other part of the canal! Surely it ought not to be very difficult to construct a "plough" on the vacuum, or other suction principle, which, started out as soon as the snow began to fall, should draw it up and pass it through a pipe to a trailing car or cars of the "gondola" type—"coal cars" commonly called. It would not be necessary for the railway company to own these cars, as they could doubtless be hired for the occasion from the steam railroads.

It may be said that the expense of such methods would be prohibitive. That may be questioned. There would be a great saving in the hire of men; if not through a reduction in the number of men, it would certainly come in the number of hours of work. This would offset the expense of equipment. And it cannot be urged that this equipment would be used only after the heavy falls of snow that occur rarely. Even after a light snow vast piles are accumulated at intervals. The power shovels would remove these piles instead of the long ridges. And, even if the item of expense is still brought up, the loss to the city by street delays and congestion is too great to allow the argument to have much weight. Certainly when "power" has been so successfully applied to all other engineering problems to supplement and expedite hand work there is no need to lag behind here. And the removal of snow from the streets of a vast city is, in a way at least, an engineering problem which can be solved largely through the application of "power." P. A. HUTCHINSON.

New York.

An Improved Box for the New York Fire Alarm Telegraph

By Herbert T. Wade

FIRE alarm telegraph apparatus, in the opinion of many electrical engineers, has failed to keep pace with other departments of the application of electricity, notwithstanding the fact that upon its operation depends the safety of life and property. In this connection the fire alarm telegraph can be appropriately compared with railway signaling, where absolute sureness of operation must be provided and failure absolutely obviated. Indeed, the analogy could be pursued further and the similarity of circuits, their location and operation exposed to conditions of weather and temperature, their lack of attention requiring automatic operation, and their infrequent and irregular use, could be emphasized.

Accordingly, progressive electrical engineers interested in fire alarm telegraph are paying more attention to railway signaling and endeavoring to apply some of the solutions of problems that have been achieved amid the rapid development of this art.

But this involves a comparison between what is best in modern fire alarm telegraph practice and theory rather than with actual conditions as they exist to-day in many cities, and particularly in New York, where circumstances are such as to compel the reconstruction of the fire alarm telegraph as rapidly as appropriations are available. In this reconstruction, which for lack of means is taking place piecemeal, it is necessary to provide new elements of the best quality that will fit into the final scheme, yet at the same time will work under present conditions. There are on the market fire alarm boxes of the non-interfering and succession type, which, under good conditions of maintenance and especially with proper circuits, can be operated so as to eliminate the interference of two or more boxes operated simultaneously on the same circuit, but it must be remembered that in any city, and especially in New York, the status of the underground conductors frequently changes and that faults due to various causes, crosses from high tension electrical conductors, and other failures, are likely to develop. While in New York in particular not only are the present cables and circuits in the main badly arranged and maintained, but often as many as 50 boxes, and most of these of an antiquated and ineffective type, are placed on one circuit where 10 or 15 at the most would be considered good practice.

With such conditions in mind and new boxes required for natural extensions as well as for much needed replacements, it occurred to Mr. Leonard Day, sometime chief of the fire alarm telegraph bureau of the New York Fire Department, that a box should be developed in which all the features of the best non-interfering and succession boxes should be preserved, but in addition there should be considered further protection in view of the many defects which exist in the present circuits and which in less number might reasonably be expected under any future circuits installed under more effective conditions and of better materials and design.

It will be recalled that the making and breaking of a circuit for sending an alarm signal from a box in a fire alarm telegraph is produced by the revolution of a disk notched at its circumference, so as to afford teeth which engage a follower operating the circuit-breaking mechanism proper. The number and spacing of the teeth on the circumference of this wheel gives the signal of the individual box. Thus, if there is one tooth followed after an interval by two, and after a second interval by three, the signal 123 will be sent in to the central station. This wheel revolves by clockwork when the hook in the street box is pulled by the person sending the alarm, and makes a certain number of revolutions. The circuit thus broken and made affects a sensitive relay at headquarters, and this actuates a second circuit connected with the recording and indicating mechanism, so that the appropriate signal can be sent out to the gongs and indicators in the fire houses on other circuits.

With several boxes on the same circuit it is quite conceivable that two or more boxes might be pulled simultaneously, as has been said, and the signal either be totally destroyed or come in badly jumbled, or in case the circuit is broken, no signal transmitted at all.

In the new New York box developed by Mr. Day and Mr. E. A. Faller, the first revolution of the wheel tests out the circuit and, if it is perfect, the ordinary transmission over the metallic circuit takes place. If, however, the circuit is faulty, the line is automatically grounded on the side where the fault occurs and the signal is sent to headquarters through the ground and over the part of the line that is in good condition. This is accomplished by having an armature released after a single revolution and then by a snap switch connecting the circuit to the ground. The operator at headquarters in the meantime has received a danger signal showing that the circuit is broken, and he immediately turns down a knife switch, putting on to the particular box circuit indicated a powerful split battery sufficient to overcome any resistance, so that the current properly interrupted by the contact wheel can be returned through the ground and the signal received in the usual way. Thus it will be seen that whatever the length of the circuit or the number of boxes, it is possible in case of a break or failure, to use the ground with the portion of the circuit intact, the only contingency not provided for, and that very remote, being where a box between two faults is cut off from the central station.

Another important feature of the new box, and one which is common to all the essential elements of the reconstruction of the New York fire alarm telegraph, is that these boxes are absolutely interchangeable. Should a street box be impaired, a mechanician can be dispatched at once carrying a substitute box in a small case, and it is the work of but a moment to remove the mechanism of the box that is out of order and replace it with one in proper condition. This obviates the unsatisfactory and inefficient method of street repairs and insures better work at the instrument shop at the central station.

The new box is remarkably simple in its construction, and is so arranged that large quantities can be made by proper and modern mechanical methods. The fundamental patents on the Gamewell non-interfering succession box, which has been largely used throughout the United States, expired on February 14th, 1913, so that it is possible to make use of all desirable features of this well-known instrument, but, at the same time, the New York box is distinctly in advance of any previously constructed, and its installation in sufficient numbers will prove most valuable in the scheme of reconstruction now in process. This reconstruction of the New York fire alarm telegraph involves the provision of new central stations in three of the boroughs, new switchboards and other central station apparatus.

Barranquilla to be Made a Seaport

A LAW has been signed by the President of Colombia providing for the opening of the bar at the mouth of the Magdalena, in order to give sea-going vessels access to the city of Barranquilla, the commercial metropolis of the country. At present goods and passengers bound for Barranquilla are landed at the makeshift port of Savanilla, or Puerto Colombia, which is an open roadstead, and requires one of the longest piers in the world to connect the shore with water deep enough for berthing vessels. A narrow-gage railway runs thence to Barranquilla. The new channel in the Magdalena will admit vessels drawing 30 feet of water, and suitable piers and warehouses will be erected at Barranquilla. This city is the starting point for the flotilla of river steamers which run up the Magdalena —the first stage in the most traveled route to Bogotá.

Citrus By-Products

THE problem of utilizing waste oranges and lemons has recently been studied by the U. S. Bureau of Chemistry with interesting results. It is found that lemons which have previously been discarded will yield from 15 to 60 pounds of citric acid per ton, so that at the prevailing market rate of the acid these culls are worth from $5 to $25 a ton. Other promising by-products are the essential oils of orange and lemon, 60 per cent of which can be recovered by methods recently devised. As much as 6¼ pounds of essential oil has been obtained from a ton of fruit, and it is worth from $2.50 to $5 a pound. The gross maximum income per ton from the best quality of culls would approximate $45. It is understood that a number of companies are considering the manufacture of these by-products.

Dr. Bell's Contribution to Radium Technology.—In the SCIENTIFIC AMERICAN of September 12th, 1903, there appeared a letter from Dr. Alexander Graham Bell, in which he suggested the imbedding of radium in bodily tissue as a curative agent for deep-seated cancers. This is probably the first suggestion of a method of treatment which is now in vogue among medical men.

The Biggest of French Dirigibles

By Carl Dienstbach

ONE of the most vexing problems of aeroplane design is to minimize the air-resistance of the many bracing wires or cables. In dirigible design inventors originally worried still less about the ropes by which the car was suspended from the gasbag than early aeroplane experimenters about the "wiring" of flying machines, both laboring under the erroneous impression that compared with the supposedly enormous resistance a balloon or even a large plane offered to propulsion, that of a thin rope or wire was trifling. Modern aerodynamic research has changed this view. Air in motion has been photographed, and it has been discovered that around a properly shaped balloon or plane air will so smoothly part and close again that it will escape easily without impeding the moving body. But a rope or wire will always push the air along bodily. Who has not wondered about the grip of the wind on an ordinary signal halyard, if one tries to straighten its curve by pulling? In the wake of a long thin cable the wind is all broken up into eddies, and if there is a bundle of wires or ropes, this effect is so aggravated that the air seems to be eventually "raked" along almost like so much hay. Practice has proved this no less than theory. When the writer once complimented Major von Parseval on the picturesque appearance of his "full-rigged" airship, he protested that the waste of power due to this very beauty was extravagant.

Little attention was at first paid to the fact that even in the first rigid dirigible of 1900 Count Zeppelin had incidentally reduced this trouble to a minimum. It was little wonder that no sooner did the Zeppelins cease to remain badly under-engined compared with other dirigibles of corresponding displacement, than they began to attain speeds undreamed of in "lighter than air" machines. By an ingenious improvement of the original suspension the Parsevals soon managed to follow suit to a degree, because their outlines, showing only envelope and one small car, were also simple. But French designers, clinging to unpromising types of large suspending stiffening frames, never equaled German speeds. Not even in details did they betray an attempt to reduce resistance against propulsion, a photograph of a French car showing a veritable jungle of exposed framing.

Germany's "Gross-Basenach" type of army design, though its suspended stiffening frame was carefully incased in cloth and made of a slender streamline shape from the outset, has on the other hand recently fallen into a certain disrepute. French manufacturers faced no easy problem when the government called on them to equal the speeds of Zeppelins, finally realizing that strong as they were in aeroplanes, an entire absence of speedy dirigibles might be fatal.

While experiments with a French rigid airship, the "Spiess," essentially a frank Zeppelin imitation, were progressing with a slowness dictated by the fate of the British "Mayfly," the Spanish engineer Torres came to the rescue. Some ten years ago he invented a fundamental improvement in non-rigid airships. Laboring under the inherent difficulty of the tremendous outlay required to demonstrate a new idea in dirigibles on a scale large enough to be conclusive, which only Zeppelin was able to conquer, he offered his invention to the French Astra Company, after a futile attempt at embodying it in a Spanish dirigible of pygmy dimensions. They tried it at least on a practical scale by building after his plans one of the small so-called "vedettes" (short-range scouts) for the army, of some 1,500 cubic meters displacement. The result was an unqualified success. The modest "vedette" was able to play with the big crack cruiser "Colonel Renard," of over 3,000 cubic meters, which had won the race for dirigibles at the first aeroplane meet at Rheims.

The next Astra-Torres was not lacking in size (8,000 cubic meters). It was built for the English government simultaneously with an advanced Parseval of similar dimensions, which it easily surpassed, developing well over fifty miles an hour at the official speed tests. This lesson was not lost, and now the first mammoth Astra-Torres of 23,000 cubic meters for the French government is nearing completion. It is expected to beat the new Zeppelins, because it mounts 1,000 horsepower engines on 5,000 cubic meters less displacement, thanks to the weight saved in dispensing with the rigid frame (the whole structure weighing only 16 tons), yet the rakish slenderness (the Astra-Torres measures 110 meters in length by 19 meters greatest beam) of a rigid hull and its unchanging shape, which Count de la Vaulx, in piloting the "Spiess," found such a blessing to the helmsman, have also a say in that matter.

The wonderful invention of Torres, on which such high ambitions are based, was very simple and obvious. That von Parseval did not make it was a wonder, as he virtually had it in his hand when establishing his elaborate tackle inside the gas space for controlling his airbags. It shows strikingly what constitutes the true inventor. Torres simply conceived the immense advantage of bracing a dirigible inside the gas space, which sheer habit of early ballooning had forbidden. This conception is indeed fundamental and involves the essential superiority of the dirigible over a mammoth aeroplane. Both types need an increasing amount of bracing as their size grows larger. But the necessity of exposing the braces, whatever they be, to the supporting air current in the aeroplane, whereas they can be all safely stowed away inside the streamline, gas-inflated body of a dirigible, eventually most curiously reverses the speed relations of aeroplane and dirigible. A mammoth aeroplane may be said to be just as much slower than a dirigible as a normal aeroplane is faster. The essence of the Torres invention was shown by the writer in the columns of this paper in his study of the dirigible of the future in 1911, where not only bracing is seen criss-crossing the interior of the hull, but where cables are run through the very gas. Just as von Parseval did not see that his suspension could be placed within the gas as easily as his airbag control, Torres did not see that an empty folded gas container was not a necessary condition of running ropes through the space later occupied by the gas. The idea of employing a "smoke helmet" or a modified diving suit to attach such ropes anywhere right in the gas space of a rigid dirigible, after inflation, would seem most obvious, if it did not involve the unused chance of doubling the strength of a Zeppelin, with all its consequences of saving dead weight and gaining speed. The simplest way to describe the Astra-Torres is in referring back to the study of the airship of the future mentioned above, where a rigid quadrangular structure divided the interior of the cylindrical hull. In the Astra-Torres this same structure is made triangular, equilateral, with the base line on top, and of course of flexible cloth bands, connecting the three principal longitudinal seams of the envelope. It fulfills the identical purpose of taking part of the supporting upward pressure of the gas off the side of the hull and transmitting it straight down; as the French say, it makes the envelope "labor" less. Along the upper corners of this triangle a system of suspension ropes is attached which much resembles that of the old Parsevals in its rapidly diminishing ramifications; only the ropes of course do not bear against the outside of the envelope, but converge in straight lines through the gas space, and to facilitate their egress to the air the few final cables are first caught from both sides in a "collecting ring" to which a short vertical cable (there are ten for each car) is attached, which passes through a protecting ring in the bottom of the envelope and on the outside branches again into two diverging cables running to the two sides of the cars. For greater strength they are fastened to both sides at the bottom. For some distance they are incased in an "accordion" sleeve or hose outside the hull, which communicates with the gas space and is glued to the cable at its sealed lower end, preventing escape of gas under pressure, yet permitting that amount of play for the cable which is necessary in a flexible, elastic structure.

The internal bracing being too simple to keep the envelope cylindrical (a more complicated system might be in imminent danger of getting entangled while the empty envelope is laid out for inflation), the hull of the Astra-Torres shows the characteristic shape of three separate bulging ridges, giving an unpleasantly large outside surface, which, with its frictional resistance, is regarded as a lesser, necessary evil. Attaching ropes after inflation would obviate it. The general outlines, two cars with stiffened funnels through the envelope to observation and gun platforms on top (riding there on a sort of "saddle frame"), the concentration of all steering and stabilizing planes at the poop of the hull, are obvious adoptions from the Zeppelins, while the accompanying detail of a car shows the best features of Parseval practice, such as two motors for each "Chenue," of 250 horse-power each, each driving its own screw, improved propeller mountings of small air resistance. There is the well-tried Astra spring mounting for the motors and the convenient Astra "bridge" for the captain and his staff, but it is

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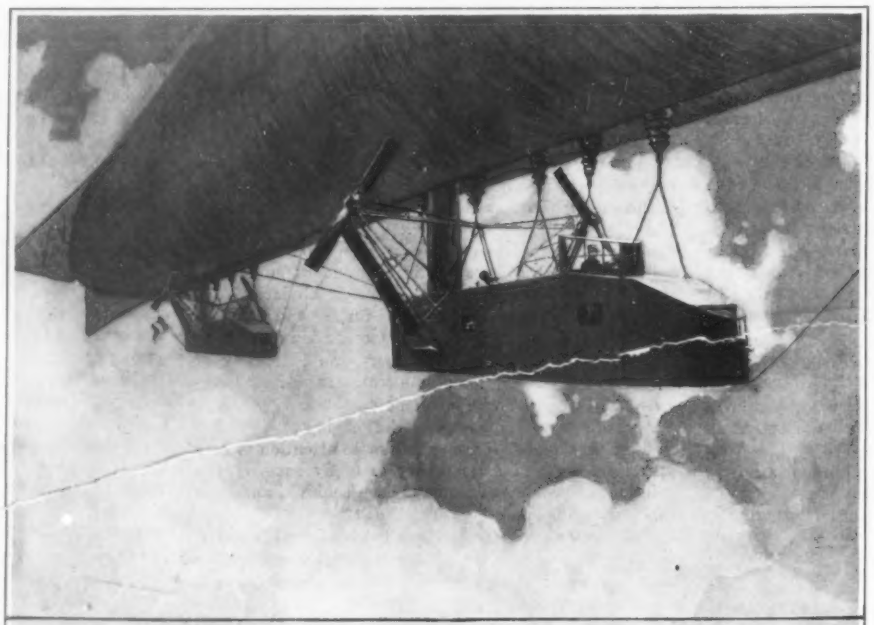
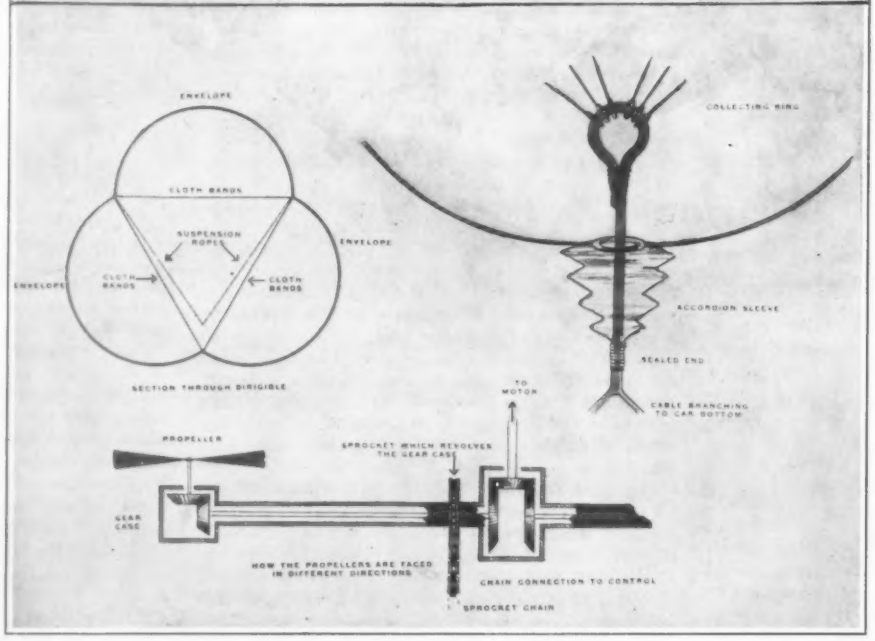




Details of the mammoth Astra-Torres.

Her gas capacity is 23,000 cubic meters. Her engines deliver 1,000 horse-power. Her length is 100 meters. The gas bag is braced within by cloth bands. This bracing transmits part of the supporting upward pressure of the gas straight down. A system of suspension ropes leads down from this bracing, the ropes being first caught from both sides in a collecting ring to which a short vertical cable is attached which passes through a gasket in the bottom of the envelope.

How to Leave Yourself at Your Tailor's

WHEN your measure is taken by a tailor he lays his tape about your chest, your waist, along your arms and your legs, in accordance with a system which tradition has laid down. However carefully he takes his measurements, the clothes must be tried on at least once and even several times if you are a very particular man. It would be more convenient if you could leave yourself, as it were, at your tailor's and proceed about your business, knowing that when your clothes are delivered they will surely fit you.

This paradoxical achievement is the fundamental idea of a German invention which has been introduced in America by a well-known New York tailor. The German inventor has actually devised a means of creating your artificial double, which your tailor uses exactly as if he had your own person to drape.

First of all you slip on a cheese cloth or linen coat, whereupon your tailor proceeds to wrap gummed paper over you with a special contrivance. He wraps the paper around your waist, passes it around your shoulder and sees to it that the edges overlap. When every part of your trunk is incased in wrappings, like an Egyptian mummy, the first stage in the preparation of your artificial double has been completed. The wrappings dry very quickly, and become hard and impervious to air. When they have reached that condition, the wrappings are slit up the back, as one of the accompanying illustrations shows. A cast of your trunk has been obtained as it were, which is peeled off like an orange skin. The wrappings are then placed upon an inflatable rubber bag of the proper shape and fastened in place. Next the rubber bag is blown up, and the wrappings are filled out and assume the exact shape of your trunk. Your artificial tailor's double has been created.

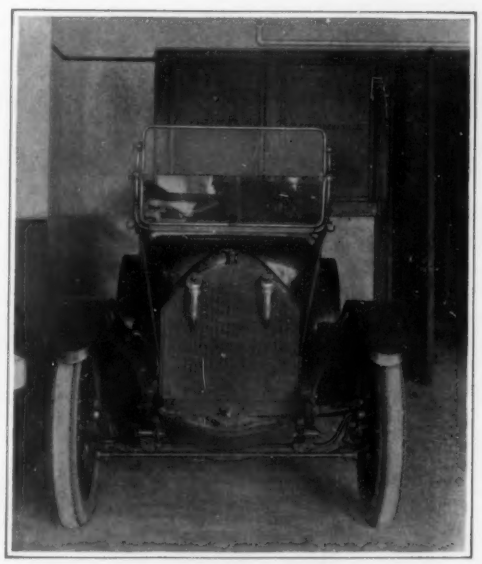
A way of creating an artificial double of yourself for the use of your tailor.
You are wrapped in gummed paper, the wrappings are cut at the back and peeled off, and the shell of yourself thus obtained is placed over a rubber bag which is blown up and thus assumes the form of your trunk.

Once your measure has been taken in this novel and very accurate way, you may cable your order for a suit of clothes from Kamchatka with the certainty that when they reach you they will fit you as if you had tried them on.

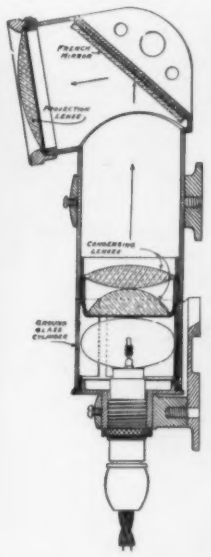
The device with which the wrappings are applied is very simple. Its details are very completely revealed in one of the small illustrations published herewith. A reel of special paper passes under a guide roller, past a wet sponge and over a serrated guiding edge. The reel, the guide roller and the serrated edge are held together by a casing which is hinged on one side, so that all the members can be taken apart.

Another Automobile Head Lamp

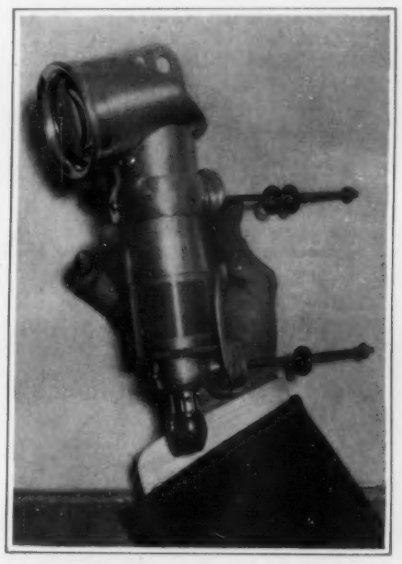
ALTHOUGH automobile engineering has progressed marvelously during the past few years, the fact remains that until very recently comparatively little attention has been paid to lamps and lighting systems—barring the introduction of electricity as an illuminant, of course. We have better illumination of objects as viewed from behind the driver's controls, what with high-power tungsten bulbs and parabolic reflectors, but the numerous unsuccessful attempts that have been made to control the blinding glare that is such a menace to the operators of approaching vehicles makes plain the inherent defect of such systems. Now, however, there has been placed on the market a radically different type of automobile head lamp in which the inventor has sought to eliminate the glare by the simple expedient of controlling the beams of light and confining them in such a way that they are projected in nearly parallel lines. Thus, by placing the lamps themselves rather lower than is usual and directing the light beams slightly downward, so that those approaching the lamps, even on foot, find it impossible, without glancing directly along the projected beams, to be blinded by the "flash" of the projecting lens, the object is attained. The secret of the success of the lamps lies in the fact that the circle of light projected has an absolutely sharp edge even to the limit of projection. The projection renders objects distant about an ordinary city block and a half quite distinct, and in this connection the inventor points out, it is the quality of the light rather than the quantity that is of greatest importance.



The headlights may be secured to the radiator by means of long bolts.



Arrangement of the lens and reflector.



Added to the searchlight beam there is a widely diffused illumination.

As already has been explained, the construction of the lamps is radically different from anything else of its kind, a fact which is made plain by the accompanying illustration and cross-sectional drawing showing the bulb and lens positions. The principle, be it added, is almost exactly akin to that of the side-walk projector, which a short time ago was in such vogue as an advertising medium.

The body of the lamp is tubular and a fairly large mushroom-shaped tungsten bulb fits into an Edison socket at the bottom. A condensing lens is placed directly above the bulb and above that again there is a double combination projecting lens which directs the light against a French reflector set at the proper angle in the hood to reflect the beams through a plano-convex lens. The bulbs consume approximately four amperes when connected in parallel. A switch to connect them in series for city driving is provided.

In the tubular portion of the lamp body immediately surrounding the bulb and lens system, there is inserted a ground glass cylinder through which a soft, diffused light filters and partly illuminates the front of the car. Obviously, the amount of light diffused can be varied by altering the characteristics of the ground glass cylinders.

As the picture makes plain, the lamps are attached to the radiator of the car through the medium of long bolts running through it; owing to their lightness, it is stated that vibration can cause no harm to the comparatively delicate radiator. In another style, provision is made for attaching the lamps to the dash in the orthodox manner.

A Far-reaching Trade-mark Decision

JUSTICE VAN ORSDEL of the Court of Appeals of the District of Columbia has handed down a decision in the Asbestone Company, appellant, versus the Philip Carey Manufacturing Company, appellee, patent appeal No. 885, in which he holds in a trademark opposition that where the name of an "individual, firm, corporation or association" is sought to be registered, the right of opposition is statutory; that proof of actual damage is not required, and that applicant need not be engaged actively in the business for which it was alleged it was incorporated; accordingly, he sustained the opposition.

This decision will not only extend to opposition proceedings, but will open a new field for the rejection of trademark applications by the Patent Office as well as provide for the registration or entry either officially or otherwise of corporate names in the Patent Office so they can be utilized by the Patent Office as references against an application for registration. It is probable that it will be necessary for the corporation to file a certified copy of its articles of incorporation or some other certified evidence of its corporate existence, so the Patent Office can utilize the material as a reference.

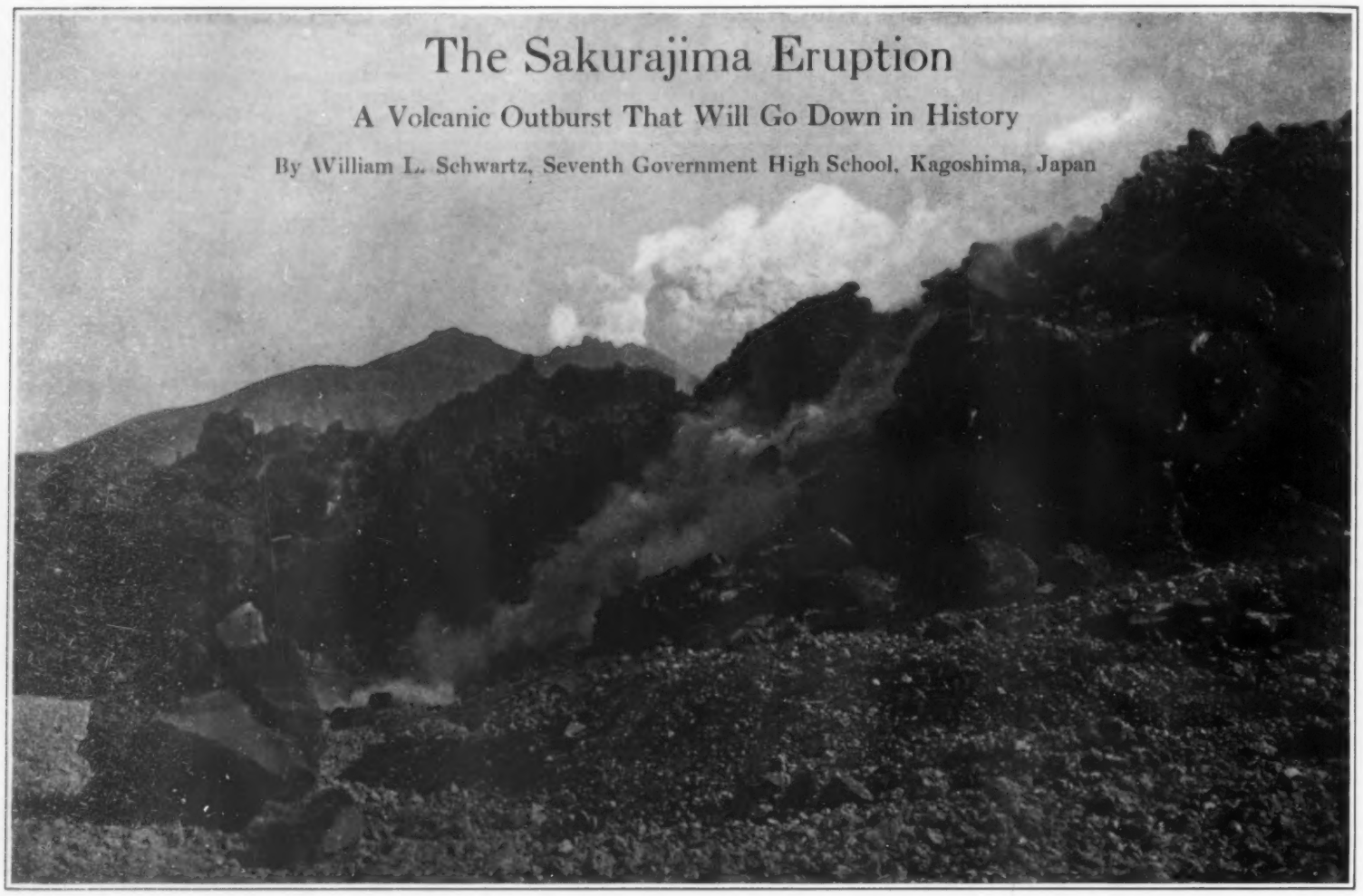
If the corporate existence is sufficient for purposes of opposition it is not going too far to say that it will also be a ground for cancelation proceedings. With the enormous number of commercial corporations whose titles or corporate names include high-class trademark matter, it is manifest the field of search by the Patent Office will shortly be greatly enhanced.

Coal Smoke as a Cause of Cancer was the subject of a paper presented by Sir William H. Bennett at the recent Smoke Abatement Conference in London. Starting with some observations by C. E. Green to the effect that there was a distinct relation between the occurrence of cancer and the kind of fuel used for domestic purposes, he detailed the results of investigations on this subject in Nairnshire, the Orkneys, and elsewhere. The incidence of cancer was found to be limited to regions where coal was the staple fuel, whereas where peat was used, cancer was almost non-existent. The main exception to this statement is that a comparatively high cancer rate is found in certain peat-burning districts where the peat is a hard, black substance, burning with a long flame, not smoldering as does ordinary peat. A large sulphur content in the fuel is associated with the occurrence of cancer. The speaker pointed out that if these results were confirmed, they would form a terrible indictment of coal as an ordinary fuel.

The Sakurajima Eruption

A Volcanic Outburst That Will Go Down in History

By William L. Schwartz, Seventh Government High School, Kagoshima, Japan



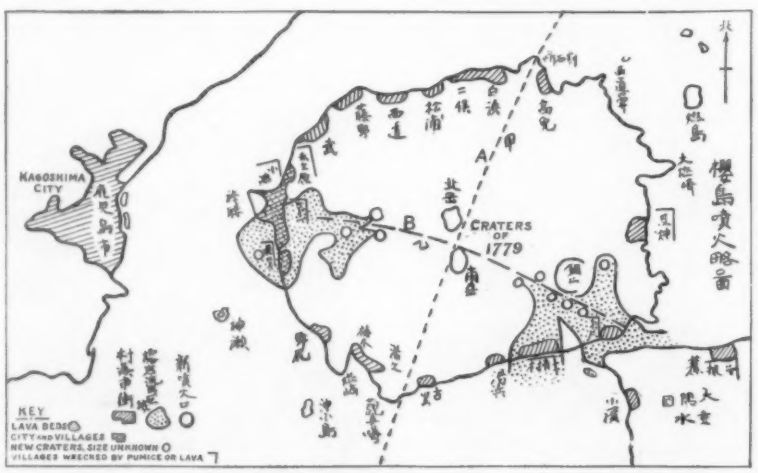
The western lava bed in motion.

EVER since assuming my duties four years ago at this Kagoshima School, I have found Sakurajima to be a favorite subject of discussion among the citizens of this place. We had frequently imagined what would take place if the dormant volcano in the bay were to reawaken to the activity which it displayed in 1779, and always with some misgivings as to our fate if such a dread disaster were to occur. Ever since the eruption, vulcanology has been the only popular topic of conversation, and fortunately we have gained not a little knowledge from the visits of Dr. Omori and other scientists. It is my belief that a selection of this gossip will be of more interest to American readers than an eyewitness's chronicle.

First of all, could the eruption be predicted? To this query I will say that it was, and it wasn't, foretold. Dr. Omori, who is a firm believer in the 60 to 65-year period of volcanic activity, has put himself upon record as having urged the purchase of a new seismograph upon the governor of this prefecture as early as last summer. A bill for the $70 representing the cost of such a perfected instrument was voted down in the end, by a thrifty prefectural assembly. As this year fell within the period of activity for the Kirishima, Sakurajima, Kaimondake volcanic chain, Dr. Omori expected an unusual eruption at some point in the range. Then again, as January 10th and 11th were marked by many earthquake shocks which continued up to the moment of explosion, the populace, especially the 21,000 Sakurajima islanders, were anticipating danger, at least a great quake. On January 11th, the hot springs at Arimura village rose three feet and the water was unbearably hot. Smoke, too, in fine lines invisible from Kagoshima city, was often noticed on this day, so that refugees first left the island at about 9 P. M. on the night of the 11th. Not a few islanders and others were waiting for an eruption, although they could not bear to put their fears into words. The head men of the various island villages frequently telephoned over to the Kagoshima Meteorological Station, but were always informed that the earthquakes were non-volcanic in character. At this point some one will say that common sense should have guided the weather prophets more wisely. But the truth seems to be that they pinned their faith firmly to the records of the antiquated seismograph at the observatory, and failed to discover the true center of the seismic disturbances. Hence, the eruption was vaguely anticipated by the best-posted scientists, and by the many islanders, all of whom escaped but two, yet it was not foretold by the weather observatory. In a sense, an imperfect seismograph must be condemned as affording no protection.

Then again Dr. Omori at Tokyo, and my colleague, Jirs Sasamoto, Esq., lecturer on mineralogy, were both able to foretell the issue of the eruption which did take place on the 12th, and to declare that the city of Kagoshima would escape serious damage. These splendidly audacious and accurate prognostications were based upon an intimate knowledge of the geology of the island, and the fact that volcanic earthquakes are never very violent. Sakurajima is a much worn cone of andesite, soft at that, and covered with layers of tufa and volcanic ash which could not resist any great subterranean force without yielding. Again, the prevailing northwest winds which blow almost incessantly until April, offered an almost certain protection against pumice showers, etc. These gentlemen also knew that a tidal wave could not rise in such a deep and narrow passage (2 miles wide, 80 fathoms deep) as that which separates Kagoshima from Sakurajima unless the mountain were to drop into the sea almost instantaneously. An old volcano like Sakurajima would not be likely to do this.

Prof. Sasamoto was consulted by the local authorities on the day of the eruption, and his conclusions were widely posted up in the city, but his influence could not stop one of the most remarkable panics in history. A professor of psychology is said to have come 900 miles from Tokyo to investigate the mob psychology of this flight. The eruption began at ten in the morning, and with very little noise, the craters on the far side coming into activity at almost the same moment, and though a few people fled by eleven, a large number waited until about three in the afternoon, and then left without making any preparations at all. This was because the mountain was then entirely veiled in fog and ashes, and hence the volcano seemed more terrible. But at least two thirds of the population remained in their houses until 6:35 P. M., when an earthquake of considerable violence caused some small damage to every house in the city and drove out the population under the scourge of fear—fear of earthquakes and tidal waves.

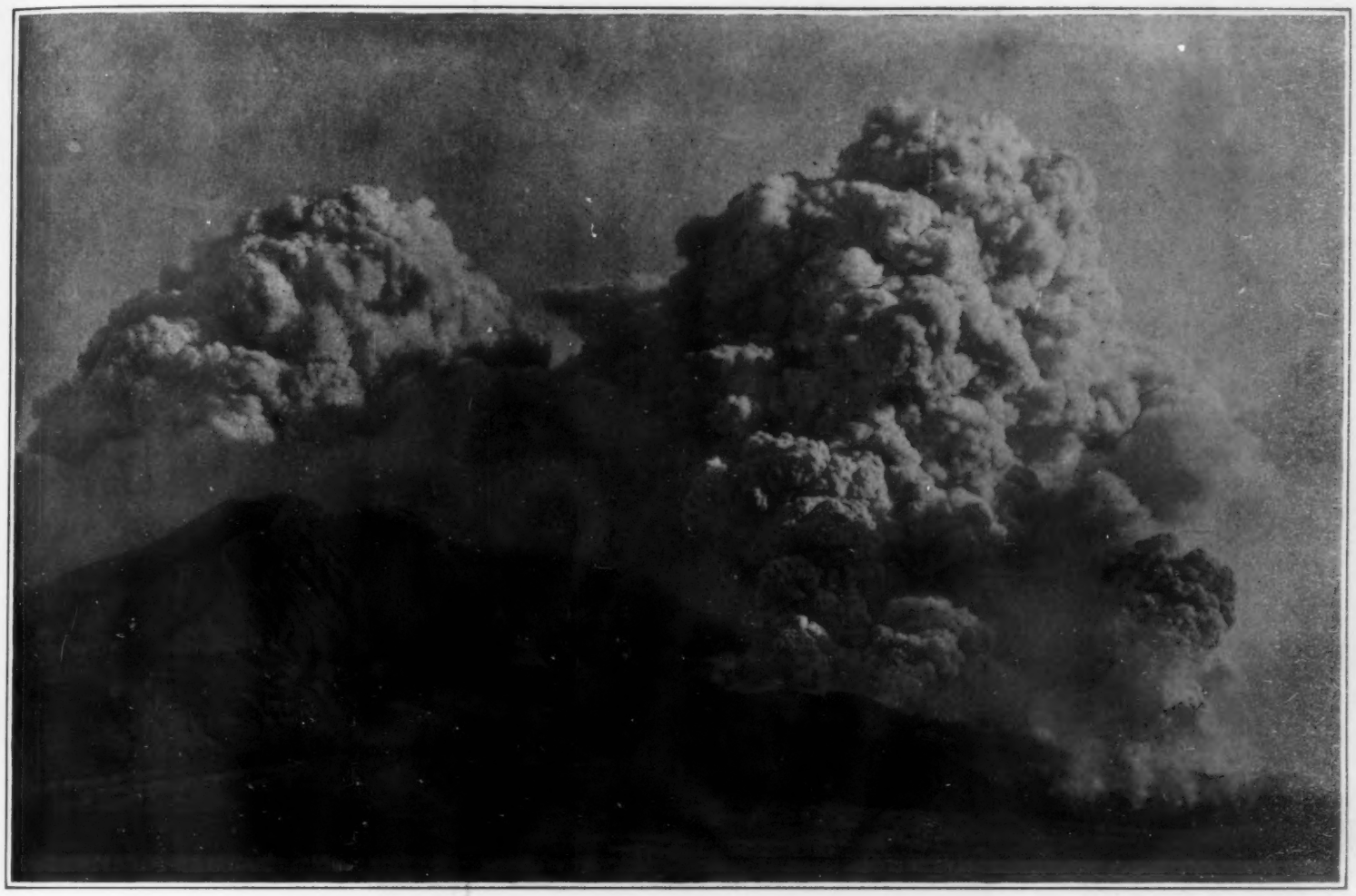


Dr. Fusakichi Omori's sketch map of Sakurajima and vicinity. Corrected to February 4th, 1914.

A. Line of the Kirishima, Sakurajima, Kaimondake volcanic chain. *B*. Line of the Ijuin Fault. (Earthquake felt with greatest force.) At the extreme left, Kagoshima city. Opposite are the villages indicated by Japanese characters which have been wrecked by pumice or buried under lava. These are, from northwest to northeast, Akabuhara, Koike, Yokoyama, the island of Karasujima, engulfed, Arimura, Seto, Ushine on the mainland, and Kurokami to the north. The lava-flow from the southeast craters has connected the island to the mainland.

This earthquake shock was felt with equal violence along the projection of the line *B* running northwest and southeast in the map. Owing to the soft volcanic rock which is alone available for building purposes in this neighborhood, stone walls were much injured, especially when they lay north and south, at right angles to the shock. This, strange to say, was the only notable earthquake that took place.

A Japanese friend once remarked to me that it was impossible to run from



The western and eastern craters on January 24th. Steaming lava is seen low down in the right-hand corner.

View of the eastern lava beds covering the site of the village of Arimura, southeastern Sakurajima. The lava has been bifurcated, as shown from the map on the previous page, by the small knoll to the left.

Ushine village on the mainland. This picture was taken amid thickly falling ashes so that distant points are not seen. The village homes are visibly covered with volcanic deposit.

The eastern craters and the ash-buried village of Kurokami.

Sakurajima dormant. Photographed from the hills behind Kagoshima.

danger in battle, but that it was his duty to leave his house in an earthquake. Among the refugees there was no wailing and no fainting of women such as might occur elsewhere, but these people did not need to shout or discuss their plans, they were all mastered by the one thought of their personal safety. Yet there was little selfishness, and on that day none of the base courage born of avarice, no pilfering. And those people who determined to stay after the earthquake were gradually driven off by appalling electrical phenomena that increased during the night, or else warned to leave the city by the police and soldiers who came in boldly to watch over the deserted city. It seems very doubtful if one thousand persons out of a population of 70,000 spent the second night of the eruption within two miles of the city.

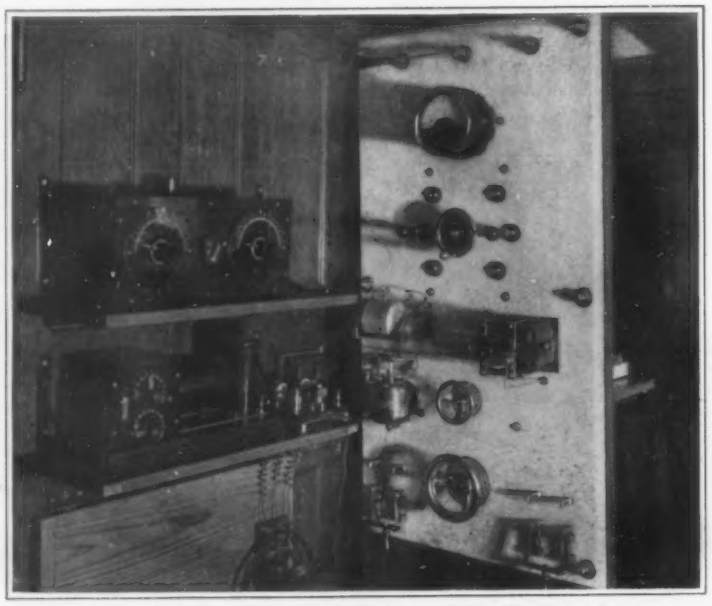
As to the characteristics of the eruption, it was pre-eminently an ash eruption at first. The force of the explosions was not great, yet as there was so little resistance ash and clouds were carried to at least 20,000 feet and the eruption seemed to be more violent than it was, and very short-lived, since there was no check upon it. On the other hand, no glass whatsoever was fractured. The electric displays were unbearable and the thunder deafening. However, there was almost no moisture, only a heavy thunderstorm of three hours on the second night that affected all of the island of Kyushu. Since this time, there have only been two short rainfalls. Hence the skies were not obscured owing to the wind, and the moonlight was a great comfort to the refugees. On the other hand, the lava flow has been unusually great for a Pacific Ocean volcano in the modern period.

Lava began to flow about 8 o'clock on the evening of the 13th, the most spectacular moment of the whole eruption, and continued to flow from the western craters until January 26th. On Monday, January 19th, the island of Karasujima was engulfed in this bed, and even as late as January 24th the whole bed was advancing at the rate of a foot an hour in Dr. Omori's opinion. The photograph shows how rocks would roll down from the crest of the lava beds as they were pushed forward. The area of the two lava beds was then estimated as totaling 10 square kilometers with an average thickness of 50 meters, making the amount of lava then emitted reach 7 cubic kilometers. On the eastern side, the craters are still exceedingly active, and lava continues to flow. The channel between Sakurajima and the mainland has been entirely filled, converting the island into a peninsula and blocking the fairway for the steamers which used to make the circuit of the island.

The injury wrought by the volcano has not been confined to the island, but is very wide in those districts of Kagoshima prefecture lying to the southeast and hence still suffering from such constant showers of ashes that no photographer has been able to get clear pictures of the affected area. We are truly thankful that their loss has been our gain, and that it is possible to flatly contradict the absurd telegraphic reports which first heralded the eruption to an astonished world.

Trees stripped of leaves and houses buried under fall of rocks and ash at Kurokami village, eastern Sakurajima. The pits seen in the photograph are caused by the collapse of the houses located here.

United States patrol that enforces wireless laws.



Radio apparatus of the motor boat "Tarragon."

Wireless Detection of Wireless Criminals

By V. Ford Greaves, United States Radio Engineer

A WIRELESS detective is maintained by the United States Bureau of Navigation, to patrol the waters along our Atlantic coasts, to trap the radio practical joker who sends out false S O S messages, to locate the station that does not observe the prescribed wave-length regulations, and in general to see that order is maintained in circumambient ether. This detective, the motor boat "Tarragon," was originally designed to act as policeman for motor boats and make them observe the navigation laws. Now it has been equipped with a very efficient radio apparatus in charge of U. S. Radio Inspector Benjamin E. Wolf, and will enforce the radio laws of the United States and the London International Radiotelegraphic Convention along the Atlantic Coast.

The radio apparatus was designed and assembled under the direction of Mr. Frederick A. Kolster of the Bureau of Standards. Its special features are compactness and facility for quick change from one transmitting wave-length to another. The transmitting apparatus and motor generator are all mounted on a panel-board 22 inches wide by 30 inches high, as a single unit. The apparatus on the back of the board projects a maximum distance of 18 inches. The motor generator is operated by 20 Edison cells, which will operate the apparatus continuously on full load for about eight hours on one charge. The cells are charged by a small auxiliary gas engine direct connected to a 35-volt, 35-ampere generator. The spark-gap is of the quenched type. A break system relay enables the operator to be "broken" or to overhear any interference while transmitting. At present the normal wave-length of the "Tarragon" is 300 meters. In addition to this, transmitting wave-lengths of 200 to 450 meters are provided for. The change from one wave-length to another is accomplished by a single throw of a six-point switch mounted on the panel board. This single operation tunes both the oscillating and open circuits to resonance, and with a slight variation of coupling, maximum radiation is obtained. The wave-length change device and the method of varying the coupling are very ingenious, and were devised by Mr. Kolster. The receiving apparatus is secured to a bulkhead, and the operating table upon which is mounted the transmitting key folds down when not in use. The complete installation occupies very little valuable space, even considering the comparatively small size of the "Tarragon."

The installation is rated at one quarter kilowatt, and on the 300-meter adjustment delivers a little over 3 amperes in the antenna. The antenna is necessarily of the comparatively inefficient inverted V type on account of the single mast available. The maximum height above the water line is about 27 feet, and the natural period of the antenna about 60 meters.

A test of the apparatus was conducted while the "Tarragon" was in the vicinity of Norfolk, Va. The "Tarragon" was able to plainly hear the time signals and weather report from Arlington, and the same report repeated by the Key West Naval Station. The press messages from Sayville, L. I., were also copied. Communication was established over a thickly-wooded country a distance of about 35 miles with the Norfolk Navy Yard Station. This indicates that the equipment has an approximate transmitting range at sea by night of 150 miles, and that the Bureau of Navigation may communicate with the vessel by wireless telegraphy wherever she may be along the Atlantic Coast.

Comparing the results of this test with those obtained by the average commercial shipboard station rated at one kilowatt and showing an antenna current of from 3 to 5 amperes and having efficient inverted L antennæ from 60 to 125 feet above the water line, it is concluded that the "Tarragon's" radio equipment is extraordinarily efficient.

Interpreting Claims.—In Hall Mammoth Incubator Company vs. Teabout (U. S. D. C.) District Judge Ray citing Winans vs. Denmead (15 Howard 330) said: "Unless there are limitations written into the claim, or imposed by the prior art, or by acceptance of a narrow claim in place of a broad one, in the Patent Office, in order to secure the patent, the inventor is entitled to every form in which his invention may be copied and to a broad construction." Also that "Hall elected to locate his levers and connecting rods, etc., where and as he did and to claim specifically all the several parts and cannot ask the Court to modify or rewrite his claim by ignoring any claimed element of his combination. He asserted their materiality by claiming them, and cannot he heard to deny it."

A New Way of Detecting Art Forgeries

The Microphotographic Study of Brushwork

By Prof. A. P. Laurie, Hewitt-Watt College, Edinburgh

Fig. 1.—Microphotograph of head in a Watteau. No. 55 in Edinburgh National Gallery.

Fig. 2.—Microphotograph of the head shown in Fig. 1, but from the copy of Watteau shown in Fig. 5.

Fig. 3.—Microphotograph of face from a Pater. No. 60 in Edinburgh Collection.

Fig. 4.—A representation of a genuine painting by Watteau. (No. 55 in the National Gallery of Edinburgh.)

Fig. 5.—Copy of the Watteau No. 55, which is apparently handled quite in the manner of the master.

Fig. 6.—Head of old man by Teniers. No. 817 in London National Gallery.

FOR some time I have been engaged in a series of researches, with a view to applying scientific methods to the identification of pictures and the exposure of forgeries. In the first place I began by making a careful investigation into the history of pigments with a view to deciding at what dates certain pigments were used in the history of painting, as it is obvious that if we have a knowledge of this, we can very often approximately date a picture, and so decide whether it was painted at the period to which it has been assigned. These investigations were carried out by the study of dated documents, such as Illuminated Missals, Venetian Ducali, and the Coram Rege Rolls in the Record Office, London, which are illustrated with miniatures from 1500 to 1700.

By means of these dated documents it has been possible to construct a fairly complete history of pigments, and to state very definitely when certain pigments came into use and other pigments ceased to appear upon the artist's palette. In addition, I have devoted considerable attention to the microscopic study of the surface of pictures, with a view to detecting repainting and identifying the pigments in position, and also to the microscopic identification of pigments, enabling one to deal with the very tiny samples which can be removed without injury to the picture.

These methods, then, enable one to decide whether the picture is a modern forgery, whether repainting has taken place, and also to date the picture itself approximately. In addition, it has been found that certain artists are accustomed to use certain pigments, so that the probability of a picture being by a given artist is strengthened if the pigment which he generally used is found upon it. It was while making these researches that I was struck with the amount of information which could be derived as to the painting of a picture, from the careful study of the brushwork suitably magnified. It is, of course, customary for all art connoisseurs to use a magnifying glass, but the information to be obtained is very much more reliable and useful if, instead of using the magnifying glass, careful microphotographs are taken of selected portions of the picture under examination.

In order to get successful results, the enlarged photograph should be taken directly on to the negative, the amount of enlargement depending on the style of the brushwork of the particular artist. As a rule, about three diameters are sufficient, but there are cases where enlargements up to as much as six diameters are of value for this purpose. By means of these photographs one is able to isolate the facts of brushwork without any confusing considerations, and one is able to compare side by side a series of such microphotographs.

Supposing, for instance, a picture is believed to be by a given artist, microphotographs of selected portions are taken and these are compared with microphotographs of pictures of undoubted authenticity by the same hand; while, if there is some other artist whose name is suggested as a possible author of the picture, microphotographs are also taken of his work, for comparison. In this way it is possible, in the case of a very large number of painters, to arrive at very definite conclusions. There are schools of painting, of course, which do not lend themselves to these methods, but, on the other hand, there are many artists whose individuality of brushwork is so marked and so characteristic as to make imitation impossible. The copyist or the pupil may imitate a master's general style, but each man has his own way of laying on the paint which is characteristic.

During the time I have been investigating this method, I have been accumulating typical microphotographs of the brushwork of many of the great masters, and every day one is learning something new as to their methods, and also as to how far a man's brushwork varies, and how far certain characteristic touches remain throughout his career.

In the case of the painters of small pictures with minute figures, such as Teniers and Watteau, microphotographs of the whole of the face are usually most useful, and the enlargement may extend to five diameters on account of the minuteness of the brushwork employed by these artists. In the case of the life-size portrait painters, it is necessary to select some portion of the face into which the artist has put the greatest amount of careful work. On the whole, the eye usually gives the most information, magnified some three diameters. In the case of landscape artists, the painting of foliage is usually very characteristic. At the same time, it is usually advisable to examine the picture very carefully with a view to seeing whether there is not some piece of rapid and characteristic painting on which the artist, working very freely, has shown his peculiar methods. In the case of Velasquez, for instance, it is often found in some portion of the painting of the figure itself—a piece of drapery or a tassel or a bit of embroidery being painted in with a rapid and characteristic hand.

There are also obviously certain dangers in an investigation of this kind, owing to the fact that so many of the great artists employed their pupils to do the less important parts of their painting, and therefore we must not be led astray by assuming the work of a pupil to be the work of a master. It is for this reason that, as a rule, it is safer to compare the more important parts of the painting.

From the large number of photographs which I have made, I select one or two typical examples, in order to illustrate the various points. The

(Concluded on page 240.)

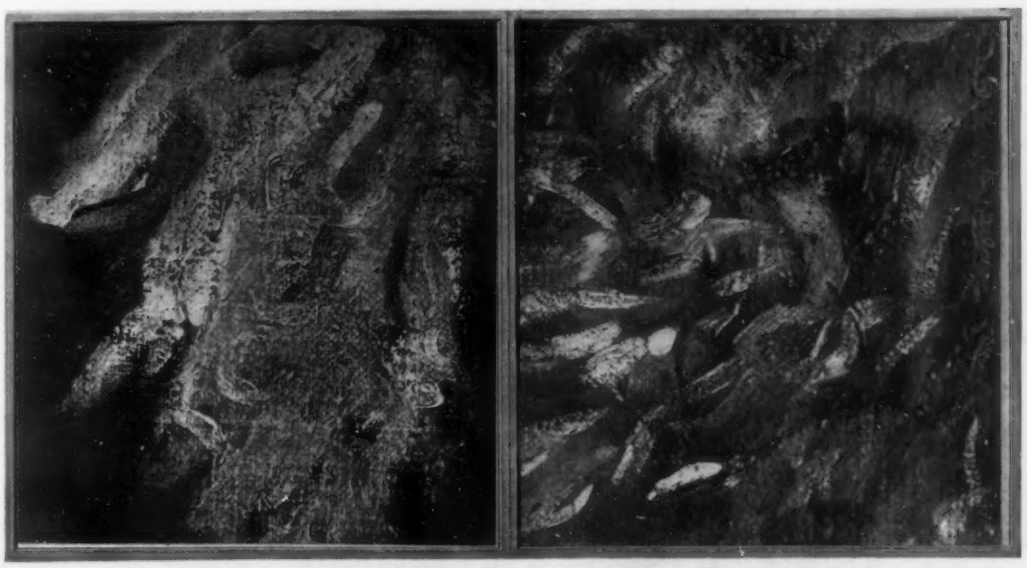


Fig. 7.—Brushwork of the "Spanish Admiral," which is attributed to Velasquez.

Fig. 8.—Brushwork in the portrait of Philip IV by Velasquez.

The Storm of March 1st, 1914, Measured in New Units

By Alexander McAdie, Director Blue Hill Observatory

IN various recent issues of the SCIENTIFIC AMERICAN reference has been made to the desirability of recording meteorological conditions in more rational units than those of the old scales. In the SCIENTIFIC AMERICAN SUPPLEMENT for December 6th, 1913, there is described in detail the new methods of representing atmospheric pressure variations in per millages (or percentages with an added decimal) of a standard pressure.

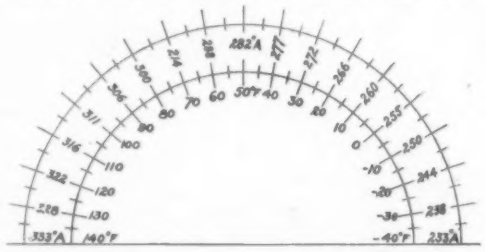
It may not be out of place to restate briefly the essential features of the new notation. First, temperature is recorded on the absolute Centigrade scale, the zero being that of the hydrogen gas thermometer, or practically 273 degrees below the zero of the Centigrade scale thermometer. We thus say "good-bye" to the Fahrenheit scale, which, serviceable for many years, has, however, now outlived all usefulness, and is practically discarded in all scientific work. It may be recalled that originally this scale ran from —90 degrees, mixture of salt and ice, to +90 degrees, the temperature of the human body, the whole making 180 degrees. Later Fahrenheit made the zero of the scale the lowest temperature of the winter of 1709 in his country, 32 degrees the temperature of melting ice and 212 degrees the temperature of boiling water under constant pressure. The other scales, Reaumur's, Celsius, and Linnæus's modification of the Celsius (the modern Centigrade) may also be relegated to the past.

The new zero is that of the hydrogen gas thermometer. Here the temperature is directly proportionate to the pressure. There is a temperature scale known as the absolute energetic or thermodynamic scale in which the ratio of any two temperatures is equal to the ratio of the heat absorbed at the one temperature to the heat evolved at the other when heat is transferred by any reversible cyclical process whatever. Unlike gas or mercury thermometer scales, the definition of temperature does not here involve a relation to any property of any definite substance. Temperatures expressed in this scale are proportional to the pressures given by a constant volume thermometer filled with a perfect gas. There is very little difference between the two scales, and while there are some uncertainties in connection with the absolute zero itself there is no great error in making the zero 273 deg. Cent. below the temperature of freezing water. For ordinary atmospheric values, we have as given in Fig. 1.

In the storm of March 1st, contrary to expectation, there were no marked changes in temperature. The record at the observatory, 195 meters above sea-level, shows a gradual rise from 273 deg. A. to 280 deg. A. The record at the base station, 64 meters elevation, is practically the same. There were no abrupt rises or falls. At the lower level it was colder from 4 A. M. until 6 A. M. than at the summit. About 8:30 P. M. the temperature fell about five degrees, the fall occurring at the higher level about twenty minutes in advance of the lower. Unfortunately there are no records available for various levels in the free air. The wind did not shift as expected and the path of the storm was evidently somewhat west of north rather than to the east. From 2 A. M. until 2 P. M. the wind was east-southeast, then backing to east and remaining so until 8 P. M., when it veered to southeast, notwithstanding this was the time of lowest pressure. The maximum velocity occurred at 6:30 P. M., 27.5 meters per second, equivalent to 33 meters per second (74 miles per hour) in the uncorrected velocities used by the Weather Bureau. At the time of lowest pressure, 7:35 P. M., the velocity was 27 meters per second, decreasing gradually until 10 P. M. and rapidly after that. With such a marked pressure fall higher velocities might have been anticipated. On February 10th, 1909, a velocity of 32 meters per second (84.5 miles per hour, uncorrected) occurred.

The total rainfall was 34.5 millimeters, and there were no unusual features either of intensity or duration. The relative humidity throughout the whole period was 100 per cent.

The feature of the storm that was remarkable was the fall in pressure (Fig. 2). The lowest reading recorded in the history of this observatory (twenty-nine years), and possibly the lowest in Weather Bureau records for this part of New England (forty-four years) occurred. In the old notation the reading would be 27.80 inches (28.47 inches at sea-level). Those familiar with weather charts know that any reading below 29.00 inches is low; but even to professional meteorologists the figures do not convey a clear cut conception of the value of the fall and the significance of the reading. In the new system (see pressure charts) the reading is 941 kilobars. If we take 1,000 kilobars as the standard pressure or absolute atmosphere then one sees at a glance that there was a fall of 59 kilobars, or 5.9 per cent. Suppose we call it 6 per cent of an atmosphere. If the height of the homogeneous atmosphere is approximately 8,000 meters we know at once that the storm caused the same decrease in pressure that a rise of 480 meters would give. Again, it is very simple to determine the gradient either with respect to distance or time. Thus at 2 P. M. the pressure was 961 kilobars, and at 8 P. M. 941. The difference, 20 kilobars in six hours, is in units of absolute force 20,000 bars, the bar in this case being the absolute unit of pressure. We thus have (what has long been desired) a C. G. S. atmosphere, and the values of all



Convenient conversion scale, temperatures F. to A.

readings are easily comparable with other pressures, from that of ten atmospheres to the feeble pressure of radiation.

In the SCIENTIFIC AMERICAN SUPPLEMENT for October 25th, 1913, Mr. A. F. Miller has given a very interesting computation of the equivalent weight of the air displaced in the marked storm of January 3rd, 1913. He takes as the extreme pressure readings 30.30 inches and

BASE PRESSURE 1,000,000 DYNES OR 1,000 KILOBARS.

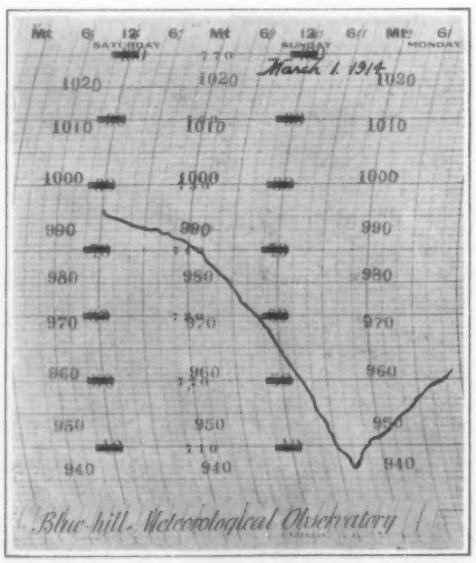
Pressure in kilobars = 1,000 +.

Barometer in inches.	.00	.02	.04	.06	.08
29.00	— 18.0	— 17.3	— 16.6	— 16.0	— 15.3
29.10	— 14.6	— 13.9	— 13.2	— 12.6	— 11.9
29.20	— 11.2	— 10.5	— 9.9	— 9.2	— 8.5
29.30	— 7.8	— 7.2	— 6.5	— 5.8	— 5.1
29.40	— 4.4	— 3.8	— 3.1	— 2.4	— 1.7
29.50	— 1.1	— 0.4	+ 0.3	+ 1.0	+ 1.7
29.60	+ 2.3	+ 3.0	+ 3.7	+ 4.4	+ 5.0
29.70	+ 5.7	+ 6.4	+ 7.1	+ 7.7	+ 8.4
29.80	+ 9.1	+ 9.8	+ 10.5	+ 11.1	+ 11.8
29.90	+ 12.5	+ 13.2	+ 13.8	+ 14.5	+ 15.2
30.00	+ 15.9	+ 16.6	+ 17.2	+ 17.9	+ 18.6
30.10	+ 19.3	+ 19.9	+ 20.6	+ 21.3	+ 22.0
30.20	+ 22.6	+ 23.3	+ 24.0	+ 24.7	+ 25.4
30.30	+ 26.0	+ 26.7	+ 27.4	+ 28.1	+ 28.7
30.40	+ 29.4	+ 30.1	+ 30.8	+ 31.5	+ 32.1
30.50	+ 32.8	+ 33.5	+ 34.2	+ 34.8	+ 35.5
30.60	+ 36.2	+ 36.9	+ 37.5	+ 38.2	+ 38.9
30.70	+ 39.6	+ 40.3	+ 40.9	+ 41.6	+ 42.3
30.80	+ 43.0	+ 43.6	+ 44.3	+ 45.0	+ 45.7
30.90	+ 46.4	+ 47.0	+ 47.7	+ 48.4	+ 49.1
31.00	+ 49.7	+ 50.4	+ 51.1	+ 51.8	+ 52.4

Example: Barometer reading 29.62 inches, convert to kilobars. Tabular correction for 29.60 + 0.02 is + 3.0. Pressure in kilobars is 1,000 + 3.0 = 1,003.0.

A convenient conversion table for pressure in kilobars. (Prepared at Blue Hill Observatory.)

28.30 inches. In the new system these would be 1,026 kilobars and 958 kilobars, and the difference 68 kilobars. In the old system, after some figuring and likelihood of error, one computes that over every 2,000 square inches the reduction in pressure would about equal the removal of one ton of air. In the new system one knows at a glance that the reduction was 6.8 per cent of the normal pressure whether expressed in units of weight or of force.



Fall in pressure in kilobars during the storm of March 1st. This is the first record of pressure in kilobars ever published.

Prevention of Mine Explosions by Stone Dust

RECENT elaborate experiments by English scientists show that the presence of considerable stone dust in coal mines tends to quench the combustion of "fire damp" and coal dust. This important work points the way to prevention of a large proportion of mine explosion, and it is to be hoped that the method will be tried out in all countries, and developed into the maximum efficiency.

It is universally agreed now that a mixture of coal dust and air is just as explosive as a mixture of fire damp or methane and air. The same is true of flour mill explosions, undoubtedly caused by the ignition of a favorable mixture of air and floating flour dust.

To understand clearly the preventive effect of stone dust, one must consider the mechanism of the reaction between two gases capable of combining with each other. When the temperature of part of the mixture is raised to the ignition point a few molecules unite first, but the heat produced by their union is at once dissipated through the remaining molecules. Of course if the entire mixture is suddenly raised to the ignition point by external heating the combination may be instantaneous and explosive, but if only a small portion of the gas mixture be heated the action takes place in two stages. The heat given to surrounding molecules by ignition at the initial point will cause them to unite if the mixture is right, and thus the flame will spread. As the flame spreads, however, the general temperature and pressure is raised to a point where practically all the molecules in contact unite instantly—the "explosion wave."

In a mixture of methane and oxygen there must be at least a definite percentage of methane to insure ignition. Less than that much methane in the mixture will not unite. With just this minimum percentage of methane a spark or glowing wire will cause combustion of the methane and oxygen on its surface, but the flame will not spread and no explosion will result. The point is that the heat of combustion is carried away by the excess of oxygen molecules. Excess of nitrogen or any inert gas would cool the flame in the same way.

With floating coal dust the mechanism is similar. A small flame from any source heats a little dust to the point of distilling off coal gas which forms an easily inflammable mixture with the air. The flame thus propagated heats the remaining dust and air to such a temperature that the intensity of molecular contacts insures almost complete and instantaneous combustion with explosive violence. The speed of this propagation of flame is enormous. Wheeler and Darwin measured it in one case as 1,300 miles an hour. The presence of suspended coal dust is accounted for by the jarring effect of the flame wave from an initial gas explosion. Thus a small methane explosion might be so in effect as to do little damage, but with plenty of coal dust in the galeries to be jarred into the air, the explosion may be carried throughout the mine. The problem is to dilute all possible explosive mixtures with inert materials, gaseous or otherwise, so that impacts between active molecules will be lessened and the flame cooled so that it cannot travel. Crushed shale, limestone or fuller's earth act in this way. It was once thought that such dust particles aided the flame catalytically, but experiments in England have proved beyond doubt that inert dust in the mine actually retards explosion.

It is worth noting that in the presence of a flame, coal dust, and air, the first action is distillation if the coal is bituminous, and second the burning of the gas so formed. After this flame runs some distance the oxygen molecules seem to hit the dust particles so violently that there is instant burning of the dust particles as a whole without further distillation. The preliminary slow burning followed by gradually increasing velocity and pressure and finally high pressures and great oscillations of flame are characteristic of both fire-damp explosions and coal-dust explosions. An initial fire-damp explosion may set off anthracite dust or even charcoal dust.

It is urged that care be taken to use only such stone dust as will not injure the lungs of miners. Obviously powdered quartz would not do. Also the dust must be applied as often as it becomes overlaid with a fresh deposit of coal dust of any appreciable thickness. Of course the heavy stone dust cannot be kept in the air ready for emergencies, but that is not necessary. As soon as an explosive wave reaches the stone dust, enough of it is thrown into the air to cool the explosive mixture below the burning point.

C. G. S. Units of Barometric Pressure

THE British Meteorological Office has decided to take the radical step of adopting the C. G. S. units, centibars and millibars, in place of the familiar inches of mercury in all its barometric measurements (instead of merely in its upper-air observations, as heretofore). Beginning May 1st, 1914, the new units will be used on the British daily weather maps, isobars being drawn for each half-centibar.

RECENTLY PATENTED INVENTIONS

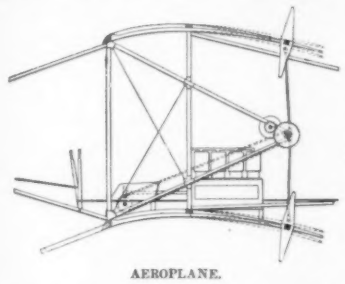
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

CORSET.—CHARLOTTE MACDONALD, care of Mrs. Edward Macdonald, Ossining, N. Y. This invention provides a corset having a plurality of vertical members, which are connected by a plurality of horizontal elastic members, secured to the vertical members, the horizontal ones being free from adjacent elastic members, between the vertical members, so that the elastic ones may act independently of one another. The corset gives the greatest freedom of movement, and especially it is desirable for women engaged in athletic pastimes.

Pertaining to Aviation.

AEROPLANE.—D. M. CALHOUN, Clarks, La. This invention relates particularly to a form of plane in monoplanes or biplanes in which the front portion is essentially rigid and non-vibrating, while the rear portion is vibratory and has connected therewith a vibrator to impart short and rapid vibrations in a vertical plane. The vibratory rear portion of the plane is contiguous with the rigid front portion, so



AEROPLANE.

that the upper and lower surfaces of the complete plane are continuous, while the rear portion, which is flexible, constitutes in effect, a fishtail propeller. The plane preferably is curved, the curve decreasing toward the rear. Vibrating of rear portion of the plane may exert a propelling force auxiliary to that of known propellers, or may be utilized alone as a propelling means.

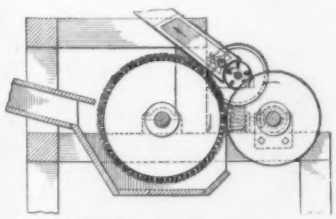
Of Interest to Farmers.

CHICKEN ROOST.—F. SCHARDT, Arapahoe, Neb. The object of the inventor is to provide a device wherein a roost is provided, upon which the fowls may perch, and means in connection with the roost for containing chemicals or the like for destroying vermin on the fowls,

CHICKEN ROOST.

and so arranged that when the perch is unoccupied, the chemical containing means will be closed, and will be opened to permit the medicinal agents to escape when the perch is occupied by the fowls.

COTTON CLEANER.—E. A. ROZIER, Sparta, Ga. The purpose of this device is to comb, card or clean cotton while the latter is passing through the gin and is being carried by the gin saws at points in the rotation of the saws where the least amount of cotton is present, and where the cotton as carried by the



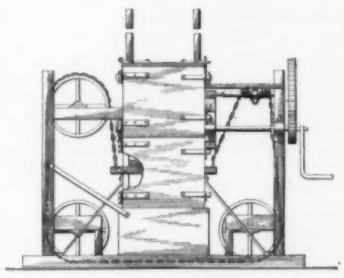
COTTON CLEANER GIN.

saws offers the least resistance to motion of the saws. By the use of the apparatus the color and general quality of the cotton are greatly improved, the cotton operated upon being as a consequence entitled to a higher grading. The engraving shows a vertical section through a gin equipped with the invention.

TRACTION WHEEL FOR PLANTERS.—E. J. OGDEN, 502½ North 6th St., Springfield, Ill. This invention relates to traction wheels for corn and other planters. It provides a traction wheel which will straddle the hills of corn or other seed. A further object is to provide a wheel with means which will effectually prevent it from slipping.

GRAIN TESTER AND SEED SEPARATOR.—A. C. ENGELSTAD, Aynyard, Canada. This invention provides a portable device by means of which seeds or grain have practically the same specific gravity. Thus the device may be used for separating wild from cultivated oats. The device is made in sections and readily taken apart to permit access to the seeds which are so separated.

BALING MACHINE.—C. F. UECKE, New London, Wis. This invention is an improvement in baling machines, and has for its object the provision of a machine for compressing any desired material, as for instance, cotton, hay or the like, wherein a pressing chamber



BALINC MACHINE.

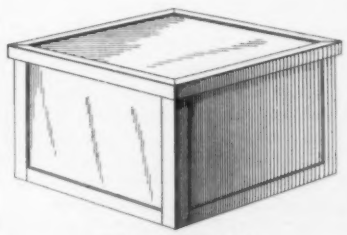
is provided, and a plunger movable in the pressing chamber, together with means for permitting the plunger to be moved manually. The accompanying engraving presents a front view of the improved baling machine.

Of General Interest.

MANUFACTURE OF ARTIFICIAL SILK.—H. TIMPE, Weesperzijde No. 125, Amsterdam, Netherlands. This inventor employs as a starting material the protein substances which remain in cows' milk after the same has been reacted on by salts of pyrophosphoric acid or pyrophosphates, and the casein precipitated thereby has been removed therefrom. These protein substances are then thrown out from the whey, and by certain means by which the finest elastic silk-like threads may be produced of great strength and toughness and adapted for all purposes where silk is employed.

MANUFACTURE OF PRODUCTS FROM INDIA-RUBBER.—H. DOGNY, 13 Ave. d'Eylau; V. HENRI, 82 Rue Claude Bernard; and E. VEIL-PICARD, 76 Ave. Wagram, Paris, France. This invention refers to improvements in the manufacture of products from India-rubber or other suitable resilient material of the kind composed of either perforated sheets or perforated and unperforated sheets of such material, which are united together and have the cavities so formed filled with gas or air whereby a pneumatic and resilient structure is obtained.

BOX CONSTRUCTION.—O. W. WARD, 96 Fifth Ave., Manhattan, N. Y., N. Y. This improvement relates to the construction of cheap strong articles such as stands, taborets and the like, and also to the construction of storing and shipping devices such as hat boxes, etc.



BOX CONSTRUCTION.

It provides means whereby devices of this character may be quickly and accurately assembled which permit a neat and ornamental appearance, the same having also the capability of being knocked down or taken apart for purposes of storing away in small places or for shipment empty.

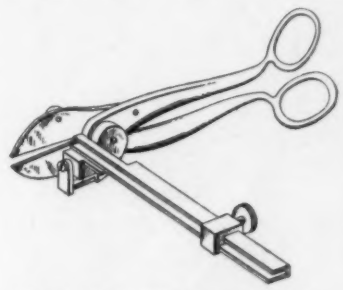
NON-REFILLABLE BOTTLE.—I. D. KELLET, 1178 Jackson Ave., Bronx, N. Y., N. Y. This invention relates to bottles, jars, etc., in the neck of which there is arranged mechanism serving to permit the outflow of liquid, but preventing an inflow of liquid. An object is to improve this class of devices whereby a container will be rendered practically non-refillable by the use of simple and reliable means.

BUFFING OR POLISHING WHEEL.—G. P. KELLER, 418 W. 27th St., New York, N. Y. This wheel is formed of a plurality of folded pieces of muslin or other fabric material. It is arranged to prevent the peripheral face of the wheel from unraveling and thus insuring long life of the wheel, and to allow using the wheel until the fabric pieces are practically used up.

Hardware and Tools.

COMBINATION TOOL HOLDER.—W. L. HANE, Ocala, Fla. Mr. Hane's invention is an improvement in combination tool holders, and has for its object the provision of a simple, inexpensive holder of the character specified, for use with lathe planers and shapers, and wherein the holder may perform a plurality of functions, thus resulting in economy in both time and labor.

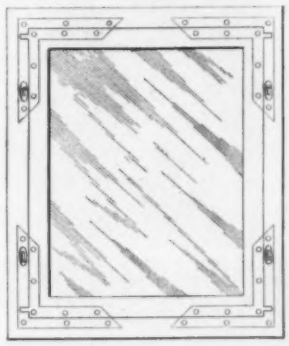
SHEARS.—C. F. ZIMMERMAN, Jersey City, N. J. This invention relates to shears for cutting sheet metal or for other like purposes; and has reference more particularly to shears comprising a member consisting of a blade and a handle, a second blade pivotally mounted upon said member and having an extension



SHEARS FOR CUTTING SHEET METAL.

pivotally connected with said second blade. It also relates to the combination of shears and a gage foldably associated therewith and having means for locking the gage in an operative position, the gage serving adjustably to determine the length of material to be severed.

HANGER FOR SLIDING SASHES.—F. B. MASLEN, Moberly, Mo. This invention has for its purpose the provision of a hinge for connecting the frames and so arranged as to permit the complete detachment of the frames or the detachment at either side of the said frames to permit the said frames to swing



HANGER FOR SLIDING SASHES.

with respect to each other. In use, either side of the frames may be released to permit the frames to swing with respect to each other, and both sides of the inner frame may be released, if desired, for removing the said frame to clean it or for any other purpose.

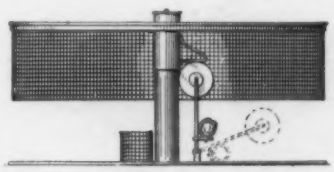
Household Utilities.

HOLDER FOR ICE CREAM FREEZERS.—F. HOSTETTER, 8905 Third Ave., Bay Ridge, Brooklyn, N. Y. Means provide for holding the freezer while the cream is being frozen, and the invention provides a holder in which the freezer may be firmly clamped in position and provided exteriorly with folded foot-boards on which the operator stands, or on which he may place a chair so that his weight will be availed of in the most effective manner in preventing movements of the holder and freezer.

WINDOW CLEANING PLATFORM.—H. BOTTJER, 631 Classon Ave., Brooklyn, N. Y. Among the principal objects of this invention is to provide a platform which may be adjusted to fit any ordinary size of a window and which will be strong and reliable when used in any position of adjustment with respect to the size of the window.

Machines and Mechanical Devices.

ANIMAL TRAP.—J. DE ST. LEGIER, 1st St., Hicksville, N. Y. This device is arranged so as to provide access to the trap from any direction when in set position, and to trap an animal alive and without danger of injury to its valuable fur or feathers. Use is made of a base provided with upwardly-extending guiding means, a bottomless cage mounted to slide



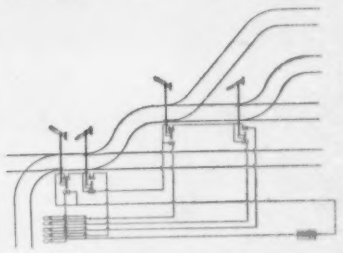
TRAP FOR BIRDS AND MAMMALS.

up and down on said guiding means, a supporting and releasing device for supporting the cage bodily a distance above the said base and for releasing the said cage to allow the latter to drop down onto the base, and locking means for locking the cage in trapped closed position.

CARD EXHIBITING DEVICE.—H. W. HELLIKER, 1271 Tenth St., Oakland, Cal. This invention relates especially to devices for holding and exhibiting cards or the like. The particular object is to provide an exhibiting device for cards for use in connection with certain game apparatus made the subject of a previous application filed by Mr. Helliker, Serial No. 730,163, and allowed April 8th, 1913, and of which this application is a division.

Railways and Their Accessories.

SWITCH INDICATOR.—C. M. ROE, 315 Webster Ave., Jersey City, N. J. More particularly this invention relates to a means for indicating to the train engineer the position of the several switches to which he is approaching. It is of advantage, in approaching a terminal, to know just what track of the ter-



SWITCH INDICATOR.

minal the engineer is coming into and be able to tell ahead of time just what curves and switches he is supposed to take. This invention indicates to the operator, in entering the yard or the limits of the terminal, just what track is open to him.

BLADE FOR RAILWAY SWITCHES.—M. GRIMALDI, mechanician, Rome, Italy. In this patent the invention has reference to a blade for railway switches and consists substantially in that the heel of the blade is revoluble around a pivot which is carried by a support movable upon a slide plate. As soon as a car has passed a switch, the blade resumes its normal position.

Pertaining to Vehicles.

SPRING WHEEL FOR VEHICLES.—W. J. LUTTRELL, Honey Grove, Texas. In this invention the improvement relates to wheels of that type consisting of an inner and an outer section of annular form, with spring cushioning devices between the sections for use in insuring easy running of the vehicle by the spring devices absorbing shocks and vibrations.

ROAD VEHICLE WHEEL.—S. H. COPE, Alma Street, Aston, Birmingham, England. This invention has for its object the construction of an improved motor or other road vehicle wheel, of the type in which a detachable rim is employed, said rim having a radially or laterally movable segment for facilitating application and removal of the tire to and from the rim.

WHEEL GUARD.—WILLIAM C. PIGGOTT, London, England. The guard comprises a depending guard member in the form of a leaf spring mounted in front of the front or back road wheel above the road surface, with facility of rearward, upward, and preferably lateral movements, on the front wheel stub or movable axle or other part of the vehicle so that the guard member will, under normal conditions, remain in front of its wheel.

Designs.

DESIGN FOR A LAMP SHADE.—L. C. TIFFANY, care of Tiffany Furnaces, Corona, L. I., N. Y. This ornamental design for a lamp shade is in bell shape, the attractively uneven surface of the shade comprising a highly original and beautiful composition in plant life.

DESIGN FOR A SET OF POLITICAL PLAYING CARDS.—M. S. OLSEN, Box 553 Minot, N. D. The faces of the cards employed in this ornamental design bear the party names. Each card is embellished with the party emblems of heads, flags, mottoes, etc., and are numbered.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

The Biggest of French Dirigibles

(Concluded from page 232.)

incased and decked over like all of the car, which shows also general streamlines, and has a pretty, windowed observatory with a searchlight in its nose. A machine gun is to protrude through a gun port in the side—rather an antiquated practice. The engine room in the center contains auxiliary machinery—a ventilator for the ballonets, and dynamos for electric lighting and the wireless, of which the instruments are carried in the observatory in the nose. The Astra plant has also worked out an efficient system of swiveling propellers, to be installed in their next leviathan. This plan has given great satisfaction on a small scale in England, but will eventually become of vital necessity, as no force of men could handle a mammoth dirigible so efficiently and economically on the ground in landing and starting as 1,000 horse-power applied to a swiveled propeller. Theoretically it would take a handling crew of 2,000 men to equal it.

Newest Way of Detecting Art Forgeries

(Concluded from page 237.)

first shows a microphotograph magnified some two and one half to three diameters of one of the heads in the well-known Watteau in the Edinburgh National Gallery. The second is the same head from a very careful copy by an accomplished artist, which, except for the fact that it is newer and shows the absence of cracks, it is very difficult to distinguish by the eye from the original. This is clearly seen on comparing the photographs of the original and the copy. But the moment that the microphotographs are compared the weakness and inferiority of the brushwork in the copy is at once revealed, and also the want of delicate modeling in the drawing of the face and the ear. The third photograph is from the well-known Pater in the Edinburgh collection, and is of great interest as showing distinct resemblances to Watteau's methods, while, at the same time, the work is facile and shallow and wanting in the rich complexity and subtlety of the work of the master.

The sixth photograph is from the head of a man in the Teniers (No. 817) in the National Gallery, London, and is an interesting revelation of the brushwork of this great artist. I may say that his brushwork is extraordinarily minute, it being difficult to understand how he had sufficiently fine brushes to put in some of these tiny strokes, which it must be remembered are shown here highly magnified and are therefore almost too fine for the eye to see in the original picture.

The next two photographs are examples of the brushwork of Velasquez, and illustrate the importance of seizing the work of the artist in a carelessly rapid painting mood. One is taken from the tassel on the "Silver Portrait" of Philip in the National Gallery, London, and the other is taken from the tassel on the leg of "The Spanish Admiral." Certain authorities have suggested that "The Spanish Admiral" is not by the hand of Velasquez, but, while a larger number of photographs would be required for absolute proof, a comparison of the brushwork in these two examples goes a long way to prove that "The Spanish Admiral" is by the hand of the great master.

Examples of the application of this process might be multiplied indefinitely, but probably the accompanying photographs will be sufficient to illustrate the process. It must not be supposed, however, that it is sufficient to take one or two photographs of a picture in order to make a proper investigation. The picture ought to be carefully studied under the microscope with a view to examining for repainting, and identifying the pigments and mediums. Certain portions should then be selected as characteristic examples of brushwork, and these again compared very carefully with other pictures supposed to be by the same master, and the whole results of the investigation both by the microscope and camera considered to-

INQUIRIES

Inquiry No. 9356. Wanted the name and address of a manufacturer who can build an *automobile wheel*, also a *cigar vending machine*. Concerns in the middle West preferred.

Inquiry No. 9357. Wanted the name and address of a manufacturer of a machine for scalloped paper favors and cups.

Inquiry No. 9358.—Wanted the name and address of maker of a machine to cut all granulate leather.

Inquiry No. 9359. Wanted the name and address of a firm that makes razor blades for all makes of safety razors.

Inquiry No. 9360. Wanted the name and address of parties making pipe fittings such as ferrules, stems and bowls such as could be used in the making up of calabash pipes for smoking.

Inquiry No. 9361. Wanted to buy a Nut Cracking Machine, especially good for Pecans.

Inquiry No. 9362. Wanted the name and address of the makers of a machine for splicing ties.

Inquiry No. 9363. Wanted the names and addresses of manufacturers of machinery for printing on intaglio copper plates.

gether in coming to any final conclusion.

These methods do not in any way supersede the work of the art expert. His opinion on the authenticity of the picture remains as valuable and important as ever. But they come in to assist him in his labors, to limit the problem that he has before him and to check by exact methods the conclusion at which he may have arrived; and in cases where art experts differ as to the origin of a picture, such methods go a long way to bringing the matter to a definite conclusion. As an example, I have been lately trying to decide who is the original painter of "The Old Grey Hunter" in the National Gallery, London, ascribed to Paul Potter, and the results obtained are at present before Dr. Bredius, who first suggested that this picture was by Verbeecq. I am also making a further inquiry into who is the painter of the portrait of Elizabeth Bas in the collection at Amsterdam, Dr. Bredius having suggested that it is probably by Bol, and not by Rembrandt.

The Tunnel Under the English Channel

THE question of the tunnel under the English Channel is quite the order of the day in the two countries interested, and especially among persons who are occupied with engineering and economic questions. Some interesting points about the proposed great work were set forth by M. Monnier, professor at the Central School and chief engineer of the North Railway, in a recent conference on the subject. From an economic standpoint the construction of the tunnel will mean an enormous increase in passenger and all kinds of traffic, and will be a source of prosperity to England, France and other nations. Capital will be easy to raise in both countries, and the cost is not expected to exceed $80,000,000. Technical difficulties appear to be less than for such mountain work as the Simplon tunnel and others. What is intended for the channel enterprise is to work in the impermeable green chalk layer, and run two circular and parallel tunnels, with a railroad track in each tunnel. Military preoccupations have now lost nearly all their importance in England in view of the good relations between the two countries, and it is considered that the enterprise cannot but add to ideas of peace and concord. The main obstacle to the realization of the project comes from the traditionalism which prevails in England, as it is held that the success and special qualities of the race largely come from the insular position of that country. However, it is claimed on the other hand that such an idea does not fit into modern progress and that in the course of time it will lose its force, so that we may expect to see the project carried out at a not very distant date.

Earthquakes and Changes of Latitude

AS long ago as 1903 Prof. Milne called attention to an apparent connection between displacements of the terrestrial poles and earthquakes. He found that in years when pole-displacements have been relatively large, world-shaking earthquakes have been numerous, and *vice versa*. Milne did not believe that the molar displacement represented by these earthquakes was sufficient to cause the polar change, but thought that both might result from a common cause. This subject has recently been investigated mathematically by Prof. R. Spitaler, whose general conclusion is that the rapid axial displacement is the primary phenomenon and the earthquake secondary.

Large Lobsters

THE New York Aquarium has recently acquired a lobster weighing 21 pounds. Although this is a very unusual weight, specimens exceeding 30 pounds have been taken. According to the *American Museum Journal*, the largest known mounted specimens in the world are two in the American Museum of Natural History; one weighed when caught 34 pounds; the other, 31. These giants appear to be perfectly normal in every respect except size.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12958) R. F. F. asks: 1. In the September 27th, 1913, issue of the SCIENTIFIC AMERICAN appeared an interesting article on "An Electrolytic Rectifier for the Garage." I would like to ask a little information on this subject, and will appreciate your assistance. As I understand, a rectifier of this type is made possible by the fact that aluminium has the peculiar property of receiving an electric current, but preventing its passage from the plate's surface, when immersed in certain liquids. This being the case, then as I see it, when the H. T. winding is at any one instant, say—polarity, as shown, the L. T. will of course be as shown. This means that the current inside the L. T. winding is flowing in the direction as shown by the arrow. As this current cannot leave the aluminium plate on the right, it must pass down the center wire and into the side of the battery, and from the—side up through the left plate and so to the—side of the L. T. winding. On the reverse side of the cycle, the conditions would be the same, except that the current then would pass through the right plate. Is this reasoning correct? And, if not, will you kindly advise me where I am wrong, and give me the right idea? A. The electrolytic rectifier depends upon the fact that aluminium is very easily oxidized, and thus, when the current passes from the iron to the aluminium, that is, when the iron is plus to the aluminium, the negative oxygen readily goes to the aluminium to oxidize it. But when the aluminium is plus to the iron, the current is largely suppressed. The result is that a succession of impulses all in one direction flows out from the electrolytic cell, constituting a unidirectional current, that is, direct but not wholly continuous. You will find the theory well stated in our SUPPLEMENT 1644, price, 10 cents. 2. I would also like to ask you what you think of the following scheme: The transformer is an auto transformer so connected that I can get about 15 volts or whatever is needed to force the 2 to 3 amperes D. C. through the battery. I would use a single-cell aluminium and iron plate of about the same dimensions as given in the SCIENTIFIC AMERICAN article. The action would be very similar to the mercury arc rectifier, the whole action being based on the fact that the current cannot leave the aluminium plate, but *will* pass to it. Of course, some little experimenting might be necessary to secure the right voltage connections and sizes of iron and aluminium plates before the proper charging rate was secured, but I do not see why this would not work. If you see where I have reasoned wrong, will you kindly advise me? A. It is not a practical arrangement to use a single cell as you propose, because only one half of each cycle is utilized, and in addition there is a slight leakage on the other half cycle, which opposes the direct current. With two cells, an efficiency of 60 to 65 per cent can be obtained. The article in our issue of September 27th, 1913, does not discuss the theory at all, but simply gives practical data, which should be closely followed. 3. Further, you have the transformer wound with a ratio of turns 800 to 240, which with 110 volts H. T. would give 33 volts L. T. As I understand, since but half the L. T. winding is used at a time, the secondary voltage really is about 15. Is this correct? What I am driving at is this: I have one or two small transformers which I have made, and was figuring on using one of them, with a secondary voltage of about 30, and using the middle tap. A. The secondary voltage will be as you have calculated, about 16.5, since one half the secondary winding is in use at once. Should you wish different voltage, you can use a different ratio of winding, and employ the method shown in SUPPLEMENT No. 1644.

(12959) S. G. asks: There is an alloy of potassium and sodium which is liquid at the ordinary temperature like mercury (NaK_2). I should like you to inform me whether this alloy has any practical uses (excepting its use in high heat thermometers, where mercury boils at 360 deg. Cent.), and especially whether it can be kept exposed to the air for any length of time? A. We are not able to give any information regarding this particular alloy and its uses. Perhaps some of our readers can supply the information desired. It certainly cannot be exposed to the air for any time. It would oxidize immediately.

(12960) S. P. asks: 1. Will you please answer this question for me? If a tree falls out in the woods, and there is no ear in hearing distance, is there any noise? Please explain this for me. A. There are two definitions of the word "noise." One is that which we hear, and the other is the cause of hearing; the sound of the falling tree, in the case which you propose, a tree falling in a forest. The same effect is produced in the air, by the tree falling, whether there is anyone to hear the noise or not; but if there is no ear to hear, there will be no sensation of hearing, and in this sense of the word there will be no noise. If you use the word as meaning a sensation, then there is no noise where there is no ear. If you mean the physical motion which causes such a sensation, then there is a noise, whether there is an ear to hear it or not. 2. What is noise? A. A noise is a disagreeable sound, because the different components are not harmonious.

NEW BOOKS, ETC.

TIERWANDERUNGEN IN DER URWELT. Von Wilhelm Boelsche. Stuttgart: Franckh'sche Verlagshandlung, 1913.

In this excellent little book Wilhelm Boelsche, one of the most popular writers on scientific subjects in Germany, discourses interestingly on those migrations in the animal kingdom which have played their part in the evolution of species. The book may be recommended for its simplicity to those German-reading Americans who take an interest in biology.

TELEPHON- UND SIGNAL-ANLAGEN. Ein Praktischer Leitfaden für die Errichtung Electrischer Fernmelde- (Schwachstrom-) Anlagen. Herausgegeben von Carl Beckmann. Berlin: Julius Springer, 1914. Mit 426 Abbildungen und Schaltungen und einer Zusammenstellung der gesetzlichen Bestimmungen für Fernmeldeanlagen.

A text book of the theory, construction and operation of telephones, with full descriptions of accessories and lay-outs. It is profusely illustrated and is a valuable book, either for study or for reference.

MECHANICS FOR BUILDERS. Part I. By Edward L. Bates and Frederick Charlesworth. New York: Longmans, Green & Co., 1913. 12mo.; 201 pp.; with diagrams. Price, $1 net.

Part I of the work in hand is designed to meet the requirements of students attending classes but one evening each week; used in this way, it constitutes a first-year course, which Part II continues as a second-year course. But the work may all be completed in a single year if the student can devote more time to the subject. The appeal of the work lies in its adaptation to its viewpoint—it keeps the builder and building requirements constantly in mind, and aims to make the examples and exercises typical and practical.

MODERN SEISMOLOGY. By G. W. Walker, A.R.C.Sc., M.A., F.R.S. New York: Longmans, Green & Co., 1913. 8vo.; 94 pp.; with plates and diagrams. Price, $1.40 net.

This authoritative monograph on present-day seismology is limited to its consideration as a branch of physics. Incidentally, it is an appreciation of Milne and his work; for this we are grateful, since Milne's position as the father of modern seismology has received scant recognition. The first four chapters deal with seismometry—dynamical theory; sensitiveness, damping and registration; the various types of seismograph; their standardization and installation. The latter part of the work comes under seismogeophysics, and treats of the theory of a solid isotropic earth, the interpretation of seismograms, and the determination of epicenter and focus. An interesting chapter is that on "Seismic Effects other than Those Due to Earthquakes." The work concludes with a statistical consideration of the subject.

THE ECONOMICS OF TELEGRAPHS AND TELEPHONES. By John Lee, M.A., Traffic Manager Post Office Telegraphs. London and New York: Sir Isaac Pitman & Sons, Ltd. 8vo.; 86 pp. Price, 2s. 6d., net.

This very interesting review of telephone and telegraph activity in its relation to social and commercial conditions is written from an English standpoint, but American practice and development occupies much space in the comparisons. Our tariff systems are commended, and we are given full praise for the degree to which we have availed ourselves of these modes of communication. The industrial and social influences and trends of telegraph and telephone operations are authoritatively sketched, and the study furnishes lessons for the present as well as prophecies for the future. The author's conclusions indicate the advisability of government ownership. He states that this is the natural conclusion to which research has led him, and not the result of any original bias.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Board of Trade Register. 1914. Toronto: Heaton's Agency. 12mo.; 590 pp.

The present issue of the Annual completes the first decade of its publication. The traveler, the business man, anyone at all interested in the commonwealth across the border, will find here a wealth of useful information relating to the industries and activities of the Dominion. Its governmental departments, its titled people, its postal and cable regulations, and its customs tariffs and rules are embodied in brief but adequate statements. Its financial information is full and authoritative. There is a list of Canadian attorneys, others of railways and steamship lines and a table gives the cost of travel. The shipper's guide is a feature of wide appeal, and its "local opportunities" presents invaluable information to those interested. There is also a list of Canadian publications, and a section of tables dealing with currency, discounts, income on stocks, wages and freight.

GRUNDLAGEN DER PHYSIK DES FLUGES. Von Dr. Raimund Nimführ. Mit 10 Figuren im Text. Wien: Druckerei- und Verlags-Aktiengesellschaft vorm. R. v. Waldheim, Jos. Eberle und Co. Leipzig: Otto Kleim, 1913.

PRACTICE LETTERS FOR BEGINNERS IN SHORTHAND. By D. J. George. New York: Isaac Pitman & Sons, 1914. Price, 35 cents.

FIRST LESSONS IN ISAAC PITMAN SHORTHAND. New York: Isaac Pitman & Sons, 1914. Price 10 cents.

Soldering and Brazing

for nearly all metals, including such difficult ones as cast iron and aluminium, have been the subjects of hundreds of paragraphs in the Scientific American Supplement. We quote a few of the more important articles, as follows:

Scientific American Supplement No. 1673—*Full Instructions for Mending or Welding Cast Iron*, gives both brazing solders and fluxes necessary.

Scientific American Supplement No. 1713—*Brazing Cast Iron and Other Metals*, gives detailed instructions for the whole operation, and formulas.

Scientific American Supplement No. 1644—*Soldering and Soldering Processes*, gives broad general information, and contains in particular a method for pulverizing solders and alloys of great use.

Scientific American Supplement No. 1667—*Some Soldering Appliances*, describes the blowpipe and the furnace in their various forms.

Scientific American Supplement No. 1481—*Soldering of Metals and Preparation of Solders* gives many formulas for soft and hard solders and fluxes.

Scientific American Supplement Nos. 1610, 1622, 1628 contain a series of three articles on Solders, covering the entire range of solders for all metals. No. 1628 contains formulas and instructions for *soldering aluminium*.

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Scientific American Supplement No. 1864—The Gyro Compass, its principle and construction.

Scientific American Supplement No. 1621—The Gyrostat for Ships describes the construction and application of the principle to prevent rolling of vessels.

Scientific American Supplement No. 1943—Gyroscopic Stabilizer for Ships, by Elmer A. Sperry.

Scientific American Supplement No. 1694—Gyroscopic Apparatus for Preventing Ships from Rolling, takes up the Schlick invention described first in No. 1621, and discusses its action and results fully.

Scientific American Supplement No. 1645—The Theory of the Gyroscope is an excellent article, treating the subject mathematically, rather than popularly.

Scientific American Supplement No. 1649—The Gyroscope, is an article giving a full discussion of the instrument without mathematics, and in language within the comprehension of all interested.

Scientific American Supplement No. 1716—A Recent Development in Gyroscopic Design, illustrates a new form of gyroscope and mounting adapted to engineering uses.

Scientific American Supplement No. 1643—The Gyroscope for Balancing Aeroplanes, takes up this interesting field, which the gyroscope alone seems capable of occupying.

Scientific American Supplement No. 1741—Gyroscopic Balancing of Aeroplanes, tells of various suggested methods of maintaining equilibrium.

Scientific American Supplement No. 1773—The Wonderful Gyroscope, gives diagrams of the Gyroscope and its action, and applications to maintaining stability of ships and monorail trains.

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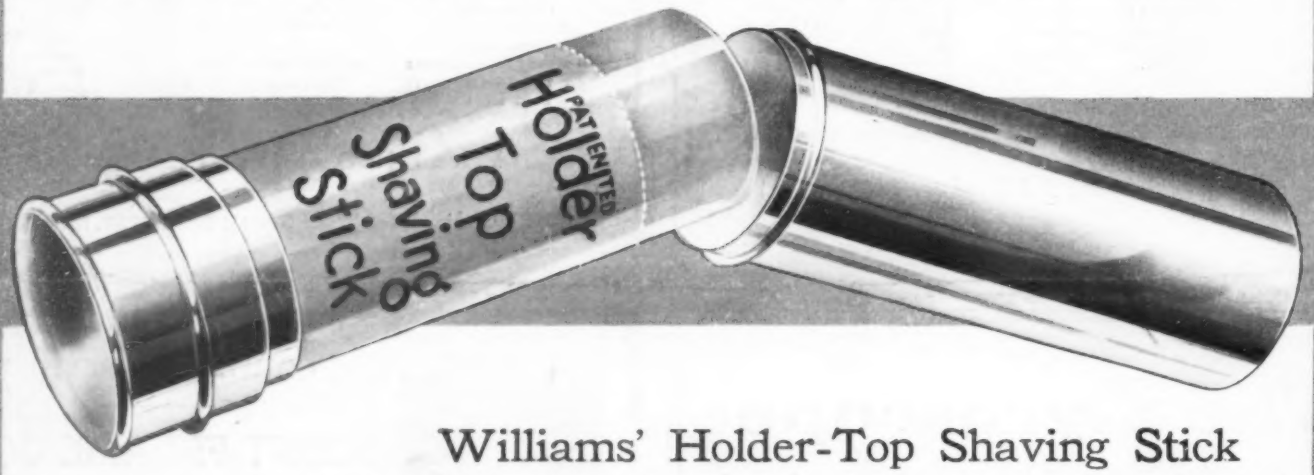

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